Educator's Guide to Riverine Studies with Special Reference to the Bronx River and its Fish Fauna

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Part I: Brief History of the Bronx River

To study a river from its source to its mouth is problematical in our consideration of the Bronx River since the original source of the Bronx River in Westchester County is now lost. The lake that developed when the Kensico Dam was first built to establish the Kensico Reservoir System has drowned it. The original dam was built in 1888, and was completed in its final configuration in 1915. Thus, the current main tributary of the Bronx River immediately below the Kensico Dam is Davis Brook, and this became, for all intents and purposes, the new source of the Bronx River.

From the base of the dam creating the Kensico Reservoir in Westchester County, the Bronx River travels south for a distance of approximately 20 miles to its mouth at the East River (see map Appendix 1). The elevation of the Kensico Reservoir is 361 feet above sea level, but the course of the Bronx River at the Kensico Reservoir Dam's base starts at an elevation of 238 feet above sea level where it is joined by its current source, Davis Brook. Thus, the "fall of the river" (the drop in elevation over distance traveled) averages about 11.6 feet per mile, a rather gentle declination. The one exception to this gentle declination is where the river rushes through the gorge in the New York Botanical Garden; here the drop in elevation through this short distance is considerably steeper.

The original course of the Bronx River was not as straight as it is now. In fact it was a highly meandering river, with many bends and switchbacks and was prone to frequent flooding. There are several small tributaries that flow into the Bronx River, and the two largest, Troublesome Brook and Sprain Brook, enter from the west approximately three and one-half miles north of the Bronx-Westchester Border in Yonkers, New York. The construction of the Kensico Dam reduced the river flow by about 25%, but did not eliminate the periodic flooding that impacted the various communities that developed along the river's banks.

The Bronx River Parkway, originally a 15 mile four lane roadway was built between 1916 and 1925. This roadway was the first scenic parkway built in the United States, and as part of its construction, the highway was designed to cause minimum disturbance to the landscape. During this construction the river was re-channeled and straightened so that it would parallel the course of the parkway and to reduce flooding; both banks were cleaned and slightly modified to create park-like settings. There was even an attempt over the years to remove invasive plant species and to replant with native vegetation. The section of the highway in the Bronx was begun in 1931 near East 233rd street, and was completed in the fall of 1960. During this construction phase many sections of the parkway were expanded to six lanes to accommodate the increased automobile traffic using this scenic roadway.

There are many small dams and waterfalls along the length of the Bronx River creating lake-like impoundments behind them. Most of these are man-made and historically many of these were the sites of mills dating from the pre-colonial period through the early 1800's. In present day Westchester County these impoundments and their shorelines have been transformed into village or community parks that add to the charm of the area. In the Bronx section of the River there still exist several complete dams and one remnant dam of historical significance. The most famous, but not the oldest of these, and the northernmost is the small seven-foot dam (Lorillard Dam) just north of the Snuff Mill in what are now the grounds of The New York Botanical Garden.

The Dutch built the oldest dam on the river in the late 1600's. This mill and dam was on the Bronx River at what is now the southern end of Bronx Park at 182nd street. There is speculation that Jonas Bronck built a mill and laid out a plantation on this site as early as 1639. Following this date, the transfer of the mill property went in 1680 to William Richardson where according to the records, the then Town of Westchester granted William Richardson and Associates the right to use the Bronck's River and set up two mills, one as a sawmill and one for grinding corn. The property eventually came into the hands of one Evert Byvanck and upon his death, his widow Tryntje in 1711 conferred to one William Provost four mills, three grist and one sawmill which were situated in the then Township of Westchester. With this transfer came a privilege of use, granted by the Freeholders of Westchester, of the stream of Bronck's River. Stephen De Lancey, Esq., eventually purchased this dam and mill, and in his will of 1735 he conferred the mill property situated on Bronck's River, and known as the mills of William Richardson, to his son Peter. The De Lancey's were a prominent family in colonial New York, and they owned and operated the mills through the end of the Revolutionary War. Since they were Tories, and loyal to the Crown, their property, including the mills was confiscated and the family fled to Canada. Following the confiscation, the property was taken over by Philip M. Lydig, Esq., who with his family lived on the property and operated the mill on this site until 1845. The Mills were constructed entirely of wood, except for their stone foundations, and were situated on the east bank of the river and stood nearly opposite the foot of present day 181st. Interestingly, since the mills were built quite close to the dam, they were powered by "overhead" water wheels. The mill was destroyed by fire in 1845, and only the stone foundation was left. Much of this stone foundation was washed away when the dam broke, as it has done several times since the fire. Some of this stone foundation can still be seen along the east bank of the river when viewed from present day River Park on the west bank just north of 181st street.

The dam was repaired and about a year after the fire of 1845 Lydig built his mill on the west bank of the river a little downstream from the site of the original De Lancey Mill on the opposite bank. This mill was also powered by three overhead water wheels and water was directed to these wheels by a raceway from the dam head. Lydig's Mill ground grist for the whole neighborhood and also grain brought up from "the then distant City of New York" by means of sloops traveling up the Bronx River. It was said that when the embankments were constructed to raise the water for use by Lydig's Mill it had to be so high as to create an artificial lake that extended about a mile up river to a point under the bridge at Bronxdale. The mill was eventually torn down when the City of New York took over the property in the 1880's as a portion of what was to become Bronx Park.

The dams built for mills, at any one site, impacted on other mill owners further up river. For example, the height of the dam for Lydig's Mill and the resulting lake impacted on the plans of the Bolton family who lived in Bronxdale and built a Bleach Mill. When water was needed to power the Bolton Bleach operation, he built a dam structure near Wilson's Hill, the site of the new "WCS/River walk" exhibit. Actually, two dams were built, separated by an island, and this formed a lake that interfered with Lorillard's plans in the construction of his mill and dam on his estate. Lorillard built his mill above his Snuff Mill in the region of the "gorge" in what are now the grounds of the New York Botanical Garden. All these latter mills were built between 1846 and the early 1850's. When these properties were taken by the City of New York for the establishment of the Bronx Park in the late 1880's, the Village of

Bronxdale was abandoned and the Bolton's moved south to West Farms and built their Bleach Mill and Tannery on the east bank of the river south of 177th street. A small dam was constructed at this site, and although now no longer in existence, part of the dam structure can still be seen on both banks of the river in the vicinity of Drew Garden's. These four dams, from north to south, the Lorillard, Bolton/Bronxdale, De Lancey/Lydig and "Tannery" dam at West Farms, were still listed in the 1896 Sewer Commission Report for the region, indicating that the Tannery dam was in tact at least until this date.

An interesting anecdote gleaned from the 15th and 16th Annual reports of the New York Zoological Society for the years 1910 and 1911 indicate that due to many fissures in the dam at 182nd street (the De Lancey/Lydig dam) and the fear that the dam might give way causing "a calamitous loss of life and property" the decision was made to have the dam repaired. This work was completed in December 1910, and as part of this work the old smooth fronted waterfall was replaced by the rustic stone cascade, which is the current facing of the dam. In addition, a 36 inch waste-way and valve was added so that the depth of the lake above the dam could be regulated both during spring flood periods and the dry season of mid-summer. This lake, Bronx Lake, became a boating lake within the Bronx Zoo and was a very popular attraction.

The last 2.5 – 3.0 miles of the Bronx River between the dam at 182nd street and its mouth on the East River between Clason and Hunts Point is a rather highly industrialized estuary, with rather more industrial activity on its west bank than on its east bank. The river is kept navigable by a dredged channel maintained by the Army Corps of Engineers. This channel guaranties a mean low water depth of seven feet. The establishment of this channel resulted from a survey report submitted in 1912 to the 62nd Congress, 2nd Session –House of Representatives - as Document No 897 and Approved R&H Act 4 March 1913, Public No. 429 H.R. 28180. This survey report justified the initial dredging of the Bronx River between its mouth and West Farms to improve the navigation of the river and the financial health of the West Farms Area. It describes the state of the river, its banks, bed, and navigation obstructions and the fact that in particularly dry summers the river bottom was exposed in regions below the dam at what is now 177th Street. It argues that dredging a channel and removing navigation impediments will greatly improve the economic value of the river, particularly in transporting coal, lime, and other commercial goods to the West Farms Area.

Selected References:

1) History of the Bronx Borough: City of New York. 1906. Randall Comfort. North Side News Press, NY xi + 422 pages

2) History of The County of Westchester, From Its First Settlement to the Present Time. Robert Bolton, Jr. Vol 2, Alexander S. Gould Press 1948. 582 pages.

Part II: Getting Started

A) Assessing the River:

1) Maps and/or charts: Before you sample any body of water it is always a good idea to have some familiarity with the topography of the area you plan to work in. The first thing you should do is obtain a map or chart for your study area. By using maps and/or charts you can get a good feel for how wide and long the river is, how deep it is, and if there are any major falls present on the river. If you have a really good topographic map, usually available from the USGS, you can even tell how steep the land surrounding the river is. You don't want to select a site only to find out that you need to be a mountain climber to get into and out of your site.

2) Consult local government agencies: There are a number of government agencies that you can contact to get information about the river you will be studying. At the national level there are several sources such as the Natural Resources Group and the National Park Service, at the State level you can contact the Department of Environmental Conservation and/or the Department of Environmental Protection, and at the local level there are a number of environmental groups and historical societies that are valuable resources of information. An excellent source of information on the Bronx River is the Bronx River Alliance. Not only will they be able to answer your questions but they can provide you with the names and contact information of people working on this river who can provide you with more in depth information.

3) Visit the river: Walk or bicycle along the course of the river. This is a great way to look for sampling sites. Only by visiting the river will you be able to determine which areas course through private property and which afford open access. This information is not indicated on maps. Also, you can get a good sense of how safe a potential area is. Evaluate the terrain as well as the vegetation. Don't pick areas that require climbing down steep slopes or walking through heavily vegetated regions to get to the river. Also remember that if you are looking for access points to the river during the early spring season the vegetation will not be in full growth. What may look like an easily assessable site during this early growth phase many not be in a few weeks due to extensive vegetative growth. Carefully assessing your potential sites is very important and takes time. Remember you don't want to put your life or that of your students and colleagues in danger or expose them to toxic plants such as poison ivy.

4) Take Pictures: It is a good idea to have a camera handy during site visits and sampling trips. We recommend that you use a digital camera for documenting site locations and for your activities on the river. By using this medium you can easily downloaded your photos onto your computer for review, editing, and printing purposes. It is also a good idea to share these photos with your students, prior to visiting collecting sites, so that they know what to expect when they get there.

B) Questions Related to Establishing a Sampling Protocol:

Once you have selected your sampling sites your next step is to determine how best to do the sampling. Consider the following questions, as they can help you make decisions on what type of equipment and gear you may need.

1) How will you get to the site?

2) Can sampling be done from the shoreline or will there be a need to go into the water to collect organisms?

3) What type of protective gear (*e.g.*. boots, waders, gloves) will be needed?

4) Is the bottom rocky or silty?

5) What types of organisms are you interested in collecting (*i.e.* plants, vertebrates, invertebrates)?

6) Will individuals have to go into the water to sample?

7) Is the area secure enough so that you can leave **passive gear** (this term is used to describe gear or equipment that you place at a site which will, without your assistance, capture organisms or record data) at the site for long periods of time (sometimes up to one month)?

8) Will sampling procedures impact significantly on fragile ecosystems?

9) How many people will be needed to complete your sampling goals?

Part III: Field Work

A) Establish a Checklist of Field Needs:

In preparing to go into the field it is important to organize the equipment and supplies you will need to take. You don't want to arrive at a site only to find that you have forgotten something. To keep this from happening it is best to prepare a **"checklist of field needs."** Before every field trip consult the list and take inventory of your equipment and supplies. Don't assume everything is there without checking that in fact it is there. We also recommend that two people go over the check list and do the inventory.

Presented below is a sample of how a checklist can be set up.

****

Checklist of field needs

Item	Quantity	Check off
Waders	______	______
Push nets	______	______
Net poles	______	______
Surber sampler	______	______
Hester-Dendy plates	______	______
Dip nets	______	______
Bucket	______	______
Resealable plastic bags	______	______
Notebook	______	______
Pencils	______	______
Velum labels	______	______
Jars	______	______
75% Ethanol *	______	______
Formaldehyde * (or some other appropriate preservative)	______	______
MS222 *	______	______
Latex gloves	______	______
Monofilament	______	______
Map	______	______
GPS	______	______
Watch/Stopwatch	______	______
10X hand lens	______	______
Insect repellent	______	______
First aid kit	______	______
Camera	______	______
Cell Phone (Fully Charged)	______	______

Items checked by (print names here) ________________________________

****

While a checklist is primarily designed to make sure that you have taken all that you need with you to your field sites, it can also be used (and should be) to check that you have not left anything in the field when finished. Therefore, you will need to use this list more than once. Rather than print out multiple copies, we have found that by placing the checklist inside a clear plastic sheet you can use it over and over. This is done by simply checking off each item, by using either a waxed pencil or crayon, on the overlaying plastic. The check marks, quantity, and names of individuals doing the checking can be wiped off the plastic covering by using a smooth cloth. The list, because it is not sealed inside the plastic sheet, can be removed to add and/or delete items from it as needed.

You will also notice that we have included, in our sample check list, a cell phone. It is always a good idea to have a cell phone handy. Should anything unexpected happen, which would require emergency assistance, you want to be able to act quickly to address the situation.

**** It is recommended that the chemical procedures discussed in this guide be done by qualified adults. If students are to be involved they must have strict adult supervision.***

B) Sampling Equipment and Techniques

1) Collecting the invertebrate fauna: Rivers are the home for many invertebrate species. In order to observe them and/or collect them one can employ a number of different methods. The simplest and virtually cost free method is to examine rocks and submerged vegetation, as these habitats are the home for invertebrates such as leeches, insect larvae, isopods, amphipods and snails. It is, however, recommended that after a rock is turned over or removed during the observation process that the rock be placed back into its original place.

There are a number of other methods, commonly used by aquatic ecologists for collecting small invertebrates. These require the use of specific sampling devices, which can be purchased, made, or borrowed from others. We will highlight three of these methods.

The first method requires the use of artificial substrates called **"Hester-Dendy Plates"** (Hester & Dendy, 1962) (Figure 1). These devices, when placed into the river, provide artificial substrates upon which various aquatic invertebrates can colonize.

Figure 1: Hester-Dendy Plate

This simple sampling device consists of eight to ten 8 cm square smooth surfaced hardboard plates that are each separated by spacers. The thickness of the hardboard plates and the spacers are each typically 3mm. The plates and spacers are held together with a long eye bolt and wing nut so that the device can be disassembled for examining specimens. Typically these plates are placed in the river and allowed to remain there for approximately 3 to 4 weeks. Since they will be in the river for an extended period of time they must be secured so that they do not wash down river. This is done by tying one end of a monofilament line (50 lb. test) to the eye bolt and the other end around the trunk of a nearby tree or other stationery object. Once both ends are secured the plate is tossed into the river a few feet off the bank. It is important to make sure that they areproperly secured as river water can (as a result of snow melts and/or heavy rains) run quite quickly and have a rather strong flow. Because these plates are to remain in the river, unattended, for a considerable amount of time, don't be discouraged if, upon returning to a site to retrieve your plates, you find that some of them have broken free. This sometimes happens. You can, however, take measures to minimize lose by placing the plates in: 1) areas where the river is not running too swiftly; 2) areas that are not open to public disturbances; and 3) areas that are semi-enclosed.

After the appropriate amount of time has elapsed you will need to place each retrieved Hester-Dendy unit, along with a little water from the site, into its own labeled quart size resealable plastic bag. Upon returning to the lab, place the unit and the fluid into a white plastic or enamel pan. You can now disassemble the unit and rinse (using tap water) the individual plates so that the attached organisms can swim freely in the pan. The white background of the pan provides excellent contrast for removing the free swimming organisms to small petri dishes for microscopic examination. In your examining of these organisms make note of the different types of swimming actions exhibited by the various species. Once you have finished observing these live specimens they will need to be preserved for further use and for closer examination for identification purposes. Small invertebrates are easily preserved by placing them in a jar containing a solution of 75% ethanol. Make sure that you properly label the jar as discussed in Part III Section D2.

A second method for collecting insects, larva and other invertebrates from shallow flowing rivers is to use a collecting device called a **"Surber Bottom Sampler"** (Figure 2).

Figure 2: Surber Bottom Sampler

This sampling device consists of two square metal frames each of which is 30 centimeters square. One is positioned flat on the bottom and the other at a right angle to it. The latter frame also has a fine mesh net attached to it. To collect organisms you position the sampler in a flowing river with the opening of the net facing upstream. You disturb the sediment contained within the frame that is resting on the bottom of the river. The suspended sediment and any contained organisms within it will be washed down river by the flow of the river and will be collected in the sampler's net. The net can then be inverted and its contents placed into collecting jars. These materials are now ready for preservation and labeling (see Part III sections C1 and D2 respectively).

A third method for sampling insect and fish larva as well as other invertebrates is to use a device called a "**drift net"** (Figures 3a & b). This device consists of a net attached to a square metal frame at its mouth. The net tapers to its end (cod end) (Figure 3a) to which is attached a collecting vessel. The net is set into the water, secured by two metal rods, with the mouth opening facing upstream (Figure 3b). The net is maintained in position for a fixed period of time (*e.g.* 1 minute, 5 minutes). At the end of the sampling time the mouth end of the net is lifted out of the water and the material that has drifted into the net washed down into the collecting vessel. This washing is done by holding the mouth of the net horizontal and carefully dunking the net into and out of the water being careful not to allow any water to go into the mouth opening. Think of this process as dunking a tea bag into water. Once all of the material has been washed to the collecting vessel at the end of the net, this vessel is opened over a small bucket or jar. You may have to close the nets collecting vessel and rewash the net a few times to make sure all of the material is thoroughly removed from the net and collected into your bucket or jar. These materials are now ready for preservation and labeling (see Part III sections C1 and D2 respectively).

Figure 3a: Drift net showing cod end.

Figure 3b: Drift net in the water

2) Collecting the vertebrate and large invertebrate fauna: One of the best ways to collect fish and large invertebrates such as crayfish in relatively narrow river systems is to use a small net (suggested size 4 foot square with 1/4 inch mesh) attached to two poles (Figure 4).

Figure 4: Push netting in a river

This net can be used to collect organisms by adopting one or more of the following techniques. The first technique is to use it as a **push net**. Here the net is pushed through the water trapping organisms along the way. A second method is to use the net to drive organisms into confined spaces of the river in order to scoop them up. The third method is to hold the net in a fixed position and have one or two individuals disturb, by stomping, the waters in front of the net. The "stompers" usually start stomping a few feet upstream of the net and continue this action while moving towards the net (Figure 5).

Figure 5: Stomping Technique

At this point the net holder lifts the net which now contains the organisms that were driven into it by the "stompers." This last netting technique is best used in river areas that have rocky bottoms. It is also a very successful method to use in collecting organism along the shallow banks of a river. Here the net holder is positioned just off the bank of the river and holds the slightly bowed net parallel to the shoreline. The "stompers" enter the water from the shore disturbing the waters just in front of the net.

3) Determining river flow: One can determine the flow of the body of water by using a hand held flow meter (Figure 6) and a stop watch. There are a number of different types of flow meters available. We have opted to use, in our studies, a very simple and inexpensive model. To operate the flow meter you place the propeller, which is attached to a pole, into the water facing upstream (Figure 6). The propeller will spin and each rotation will be recorded, via a cable running through the pole, by a hand held recording device. Coincident with taking this reading it is also important to record the time over which the flow is being measured. We select to record flow over a one minute time period. A number of readings should be made at each station so that an average flow, for that station, can be determined. It is also advisable to take flow measurements at a number of different sites on the river in order to get a better handle on the overall flow of the system. You should, were possible, transect the river, measuring flow at each bank and midway between these points.

Figure 6: Flow meter

C) Preparation of Field Samples:

1) Preserving samples:

******* Prior to any preservation of aquatic vertebrates, these animals must be made insensitive by adding the chemical MS222 (Tricaine Methanesulphonate) to the collecting jar or bucket containing those vertebrates. MS222 is an efficient anesthetic for aquatic vertebrates and its use is in conformity with the new 2004 "Guidelines for the Use of Fishes in Research" endorsed by the American Fisheries Society, The American Institute of Fisheries Research Biologists, and the American Society of Ichthyologists and Herpetologists. The appropriate dose of MS222 is 100mg/liter of solution. Prior to going into the field this dosage should be weighed and placed into small properly labeled vials. Only a qualified adult should perform this duty and be responsible for transporting and administering this chemical. *******

Upon collecting your aquatic samples you may wish to take a few back to your laboratory or classroom for future examination and study. In order to do this you will need to preserve these samples. The best preservative to use is formaldehyde. However, care must be taken in working with this chemical.

******* Because of the potential danger to young students it may be advisable for teachers on field trips to avoid using formaldehyde preservation where possible and use the alcohol method described in this section. *******

You need to work in a well ventilated area and avoid chemical contact with your skin. Since you will be preserving your samples in the field, nature has provided you with a well ventilated area to work in. To help avoid chemical contact with your skin it is advisable to wear latex gloves. It is also a good idea to wear eye protecting goggles to protect your eyes from inadvertent splashing of the preservative. As with all chemicals you must respect them and know how to work with them. It is recommended that you read the Material Safety Data Sheets (MSDS) for all chemicals before using them. These sheets should be on file with your institute's chemical hygiene officer. You can also find MSD sheets for all chemicals by visiting the web-site for Vermont Safety Information Resource, Inc. at http://www2.siri.org/msds/index.php. This site allows you to search by chemical name to obtain its MSD sheets. These sheets can be easily downloaded and kept on file for others to read.

The preservation of small aquatic organisms in the field is a rather simple process. Most aquatic biologists make use of two types of preservatives, formaldehyde or alcohol. Below you will find the procedures for using each of these.

Formaldehyde preservation procedure

a) Place your samples into a jar containing river water. The total volume occupied by the samples and river water should occupy no more than one half of the volume of the jar.

b) If aquatic vertebrates are being preserved, add to the jar MS222 (100mg/liter). Allow the fish to relax a few minutes before proceeding to the next step. For aquatic invertebrates skip this step and continue on to step c.

c) Add to the jar the formaldehyde preservative. The amount of formaldehyde used is approximately 1/10th of the volume of water and organisms in the jar. You can eyeball this or estimate it by placing a ruler along the side of the jar.

d) Cap the jar, making sure it is tightly closed, and invert it a couple of times to mix the chemical with the water.

e) If you are taking samples from fresh water sections of the river you will need to add a buffer to your preserved sample. The buffer used is "sodium tetraborate decahydrate" which is common borax (laundry detergent). Uncap the jar and add one half a teaspoon to the jar (8 oz). Adjust the amount of "borax" accordingly for larger jars or containers. Cap and invert the jar to mix the chemicals. **Note**: Step e is not necessary if your samples are being placed into water taken from the marine environment, as this water contains natural buffers.

f) Place a label in the jar (see Part III section D2).

g) After a period of one week you should remove your specimens from the formaldehyde solution and place them into 75% ethanol. Since you will now be working indoors it will be necessary for you to do this work under a chemical hood. Be sure the hood is turned on and that there is a sink, water supply, and a large chemical waste disposal container available within the hooded area.

h) While working under the chemical hood pour the contents of your collection into a strainer that is held over the large chemical waste disposal container. The mesh size of the strainer should be small enough to avoid losing organisms. Also, since this strainer has been contaminated with formaldehyde you don't want to use it for any other purposes. So clearly label it "for formaldehyde use only." Hold the strainer, which now contains your samples, over the chemical waste disposal container. Rinse the samples a few times with tap water and likewise rinse the collecting jar and cap.

i) Place the collected material back into the freshly washed jar and overlay the material with 75% ethanol. Remember to keep your label inside the jar. Your specimens are now in a solution that is safe to work with in the classroom and specimens can easily be removed for examination purposes. These preserved specimens can be kept for many years for future generations to enjoy. The only maintenance required is that one needs to watch the level of ethanol in the jars. Alcohol does evaporate in time and needs to be periodically replenished.

Alcohol preservation procedure

Alcohol preservation doesn't work well for fish or large invertebrates such as mussels, clams or crayfish. For these organisms the formaldehyde preservation process given above must be used. For small invertebrates the alcohol preservation procedure given here is used. The use of MS222 is not required for these organisms as the use of MS222 is only required if vertebrates are being preserved.

a) Place your samples into a jar.

b) Decant any excess water that may be in the jar with your sample. It is suggested that you decant the fluid over a bucket so that you can retrieve any samples that may fall out of the jar during this process.

c) Overlay the sample with 75% ethanol.

d) Place a label in the jar (see Part III section D2).

e) Since ethanol evaporates over time, you will need to replenish its volume from time to time.

2) Live samples:

a) Field observations and release: Place your samples into a clear container, such as a large jar or small lucid viewing tank. Small fish and large invertebrates can now be observed moving around in these containers. This affords the student the opportunity to observe the characteristics of the organisms. For any fish collected the students can use the fish identification sheets (Part IV-Sec B2) provided in this book to determine what species they have. Once the observation and identification process has been completed the fish are released back into the water unharmed. It is recommended that this process be completed as quickly as possible so as to minimize stress to the organisms.

b) Aquariums: Sometimes it is desirable to bring live specimens back to the laboratory and/or classroom for display in an aquarium. If this is your goal you will need to have a clean empty aquarium available in your lab and/or classroom for the organisms to be placed into upon return from the field. To ensure that your collected specimens survive the transport from the field back to your facility you should take the following precautions. **a)** Specimens that will be brought back alive should be collected towards the end of your collecting day. Doing so will minimize stress to the organisms. **b)** Place your specimens into a bucket that has a good supply of fresh river water (in a marine environment use a good supply of clean water from the collection site). Don't overcrowd them. A standard guide is one organism per liter (approximately one quart) of water. **c)** Keep the bucket containing your specimens out of sunlight, as sunlight will heat the water and also decrease the water's oxygen content. **e)** Bring a battery operated air pump system and spare batteries with you to provide air to the organisms being transported. These pumps can be purchased from either a scientific supply house or pet store. **f)** Since running river water tends to be cool, we have found that placing small sealable plastic bags containing ice cubes into the specimen bucket helps keep the organisms cool for transport back to the laboratory and/or classroom. **g)** Bring back a few gallons of river water, or marine water, from your collection site to put into the aquarium. Your specimens will survive better if they are maintained (initially) in their own water. **h)** Provide shelters, such as artificial plants (floating and/or planted) and rocks for your organisms to hide in or behind. **i)** Follow all other standard aquarium maintenance procedures.

D) Field Notes and Labels

1) The field notebook: During every collecting trip it is important to take careful notes. Field notes are routinely recorded in bound notebooks as their pages can't be easily ripped out or lost. Since everyone does not have the same field goals the information recorded in the field notebook varies from project to project. Therefore, you will need to discover, by doing, what is important for you to record. The following is a typical field data sheet to get you started. You can modify it to meet your individual needs.

****

Field Data Sheet

Collection Date: ______________/_______________/______________
Day Month Year

Location: ____

Latitude/Longitude ____

Time of Collection: ____

Weather conditions: ____

Equipment used: ____

People involved in this collection effort: _____________________________

Physical parameters of the water:

pH: _______ D.O.: ________ Temp: ________

Turbidity: ________ Flow rate: _______ Salinity: _______

Description of the site:

Riffle _____ Freshwater _____ Estuary _____

Pool _____ Marine _____

Organisms collected:

General notes:

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2) Labels: Jars containing your preserved specimens must be properly labeled if these collections are to have any scientific value. Since the labels are going to be inside the jar and exposed to the preservative solution, they must be of a material that will not fall apart. Labels made of velum are suggested. Velum pads can be purchased from any art supply store. The velum should be cut to an appropriate size, approximately 2 inches square, in advance of the field trip. Placing them into a small sealable bag such as a Ziploc snack bag will keep them handy and prevent them from getting moist. Be sure to bring plenty of labels with you on your collecting trip. The information recorded on these labels is done **only with pencil** as ink will run. The label should contain the date and time of the collection, site location, gear used, and, if known, the species names or at least its common or descriptive name.

Part IV: The Aquatic Fauna of the Bronx River

A) What You Can Expect to Find:

The Bronx River is alive with wonderful invertebrates and vertebrates to discover and learn about. Given the dynamics of the river (e.g. freshwater and salt water sections, water falls, riffle and pools, heavily vegetated overhangs, little to no vegetated overhangs, industrial plants along its banks or lack there of) the faunal composition at any one site may not reflect what you would see at another site. This is not only true along the river's course but is also evident across seasons. The list, presented below, gives the scientific and common names for all of the aquatic vertebrates and some of the more common macro-invertebrates that we have collected during our exploration of the Bronx River, which began in 1999. Many of these organisms have also been collected by local fisherman and park personnel, and have been reported by fellow scientists in their published works on the Bronx River.

VERTEBRATES

Family Name	**Scientific Name** **Genus species**	**Common Name**
Fish (Freshwater)		
Anguillidae	*Anguilla rostrata*	American Eel*
Catostomidae	*Catostomus commersoni*	White Sucker
Centrarchidae	*Micropterus dolomieu*	Smallmouth Bass
	Micropterus salmoides	Largemouth Bass
	Lepomis auritus	Redbreast Sunfish
	Lepomis gibbosus	Pumpkinseed Sunfish
	Lepomis macrochirus	Bluegill Sunfish
Cyprinidae	*Carassius auratus*	Goldfish
	Cypinus carpio	Common Carp
	Luxilus cornutus	Common Shiner
	Notemigonus crysoleucas	Golden Shiner
	Pimephales promelas	Fathead Minnow
	Rhinichthys atratulus	Blacknose Dace
	Semotilus atromaculatus	Creek Chub
Cyprinodontidae	*Fundulus diaphanus*	Banded Killifish
	Fundulus heteroclitus	Mummichog*
Esocidae	*Esox americanus*	Redfin Pickerel
Gasterosteidae	*Apeltes quadracus*	Fourspine Stickleback*
Ictaluridae	*Ameiurus nebulosus*	Brown Bullhead Catfish
Percidae	*Etheostoma olmstedi*	Tessellated Darter
	Perca flavescens	Yellow Perch
Poecillidae	*Gambusia affinis*	Mosquitofish
Salmonidae	*Salmo trutta*	Brown Trout
Fish (Estuarine)		
Atherinidae	*Menidia menidia*	Atlantic Silverside
Bothidae	*Paralichthys dentatus*	Summer Flounder
Clupeidae	*Alosa aestivales*	Blueback Herring

	Alosa mediocris	Hickory Shad
	Brevoortia tyrannus	Atlantic Menhaden
	Dorosoma cepedianum	Gizzard Shad
Cottidae	*Myoxocephalus scorpius*	Shorthorn Sculpin
Eugraulidae	*Anchoa mitchilli*	Bay Anchovy
Gadidae	*Microgadus tomcod*	Atlantic Tomcod
	Urophycis regia	Spotted Hake
Gobiidae	*Gobiosoma bosc*	Naked Goby
	Gobiosoma ginsburgi	Seaboard Goby
Labridae	*Tautogolabrus adspersus*	Cunner
Percichthyidae	*Morone saxatilis*	Striped Bass
Pholidae	*Pholis gunnellus*	Rock Gunnel
Pleuronectidae	*Pseudopleuronectes americanus*	Winter Flounder
Pomatomidae	*Pomatomus saltatrix*	Bluefish
Sciaenidae	*Cynoscion regalis*	Weakfish
Sparidae	*Archosargus probatocephales*	Sheepshead
Stromateidae	*Peprilus triacanthus*	Butterfish
Syngnathidae	*Syngnathus fuscus*	Northern Pipefish
Triglidae	*Prionotus carolinus*	Northern Searobin
<u>Amphibians</u>	*Rana sp*	Frog
<u>Reptiles</u>	*Thamnophids*	Garter Snake

INVERTEBRATES **

Porifera		Sponges
Platyhelminthes	*Dugesia*	Flatworm
Annelids	*Mooreobdella*	Leech
	Oligochaetes	Worms
	Polychaetes	Worms
Mollusks	*Physa*	Snail
	Campeloma decisum	Snail
	Nassarius obseletus	Mud Dog Whelk
	Pyganodon cataracta	Freshwater Mussel
	Modiolus demissus	Ribbed Mussel
	Corbicula fluminea	Asian Clam
Insects	Odonates	Dragonfly
	Hydropsyche	Caddisfly
	Polypedilum	Midges
	Tipula	Cranefly
	Coleoptera	Beetle
Crustaceans	*Orconectes virilis*	Crayfish
	Cyathura polita	Isopods
	Gammarus	Amphipods
	Callinectes sapidus	Blue Crab
	Carcinus maenas	Green Crab
	Hemigrapsis sanguineus	Pacific Grapsid Shore Crab
	Palaemonetes pugio	Shore Shrimp
	Crangon septemspinosa	Grass Shrimp
Merostomata	*Limulus polyphemus*	Horseshoe Crab

* These fish are found in both the freshwater and estuarine environment.
** Many of these forms are collected from the river in their larval rather than adult stages. Your instructor can explain the differences in these life stages.

B) How to Determine What You Have Collected:

1) Make use of reference materials: Identifying the organisms you have collected can be great fun and quite challenging at times. Have you ever watched nature programs and admired those biologists that can pick up an organism and immediately tell someone what it is? While you may say that this is staged for the camera, try taking a nature walk with your biology teacher and ask him/her what things are. There are no cameras, yet we guarantee that you will be equally amazed at what can be identified by your teacher during these walks. How do these individuals get this knowledge? In the beginning it requires careful observations, use of reference materials, and of course patience. If you are trying to identify fish collected from the freshwater sections of the Bronx River you will need to use books and/or papers that describe freshwater fish. By the same token, if you are collecting fish from the estuarine section of the river your reference material needs to focus on the estuarine fish fauna. However, you must also remember that the Bronx River is in New York so in selecting your reference material, whether it is for the freshwater or estuary, focus on those that cover this state and/or the Northeast region of the United States.

In using your reference materials to identify your specimen you will be learning the key characteristics that define that organism. In the beginning the process may be slow, but the more you work at it the faster the process becomes. What you are doing is training your eye to focus on key characteristics which will eventually lead you to become that "once admired biologist" who can pick up a specimen and make that "on the spot" identification.

Reference materials can be obtained from your local and/or school libraries, from agencies such as the EPA, DEC, Bronx Historical Society, and local environmental groups that work on the River. Appendix II presents a list of references that you may find useful in exploring the fauna of the Bronx River as well as other rivers in this region.

2) Use field reference sheets: The following field reference sheets have been prepared to help you identify most of the 45 species of fish which we collected from the Bronx River. We have highlighted the key characteristics to help you with your field identifications of your collected fish. We have also indicated where you are most likely to find the fish and what type of habitat it prefers. As you explore the River you may wish to take notes so that you can develop your own field identification sheets to add to the ones contained in this guide.

Insert fish identification sheets HERE:

Part V

Conclusion:

We hope that the information presented in this guide will help you in exploring the aquatic fauna of the Bronx River. While this guide has as its primary focus the Bronx River, we encourage you to make use of it in exploring other waterways in our region. The Hudson, Saw Mill, and Harlem Rivers, for example, are home to many of the same fish we have highlighted in this guide.

As you and your students explore the aquatic fauna of the Bronx River or other local waterways it is highly recommended that you photograph all of your field activities. Use a digital camera to capture pictures of your students at work in the field as well as the organisms they have collected. All the photographs presented in this guide are from our own sampling activities and of the fish we collected from the Bronx River. By using a digital camera you will be able to quickly download the pictures to your computer, edit them and ultimately print them out either singularly or as a poster for display in your classroom or a more prominent place at your school. These types of displays go a long way toward promoting interest in riverine ecology among your students and colleagues alike.

Through your use of this guide, in exploring the Bronx River and its fish fauna, we hope that you and your students have come to appreciate this dynamic waterway. It is here for us to enjoy and explore. Since it is the home for many species of animals, as you have learned by using this guide, it is the job of all of us to see that it is respected and preserved so that future generations can enjoy it as well.

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Appendix III
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Appendix IV
Equipment Supply Companies

Aquatic Eco-Systems, Inc., 1767 Benbow Court, Apopka, FL 32703

Ben Meadows Co., P.O. Box 5275, Janesville, WI 53547-5275

Cole-Parmer Instrument Co., 625 East Bunker Court, Vernon Hills, IL 60061-1844

Sterling Net & Twine Co., Inc., 18 Label Street, Montclair, NJ 07042

Fisher Scientific, 3970 John's Creek Court, Suvanee, GA 30024

Forestry Suppliers, Inc. 205 West Rankin Street, P.O. Box 8397, Jackson, MI 39284-8397

Ward's Natural Science Establishment Inc., 5100 West Henrietta Road, P.O. Box 92912, Rochester, NY 14692-9012

Appendix V
Useful Web-sites

www.fishbase.com

www.bronxriver.org

www.siri.org/msds/index.php

www.onlineconversion.com