PHYTOPLANKTON IN NEW YORK WATERWAYS

Study of the East and Harlem Rivers

By: Katharine Conklin

Marine Biology Research Program

New York Harbor School

2017

Introduction:

Phytoplankton is the main food source for many animals and invertebrates. It's at the bottom of the food chain, which means that they pass off the most energy to the next in the food chain. There are many different species of phytoplankton in every type of water body. The focus of this project has been searching for the filaments, colonies, and unicellular groups of phytoplankton. In this project phytoplankton samples were collected from the East and Harlem River from East 116th Street to East 96th Street. Phytoplankton is part of that research. And the control site for this project is Governors Island. This project will be analyzing the quantity of phytoplankton surviving in the east river. At each site two samples are taken and then analyzed in the lab. Beta bottles will be used to collect the samples at each site. CIVITAs is a non-profit organization (Garay, CIVITAs Working for Quality In Urban Life, n.d.), which cares about improving the neighborhoods on the Upper East Side.

Materials and Procedures:

Items	Purpose	Quantity
Beta bottle (1.7L)	Capture sample	1
Bucket (5 gallon)	Hold sample	2
Sample vial (100mL) labeled	Contain Plankton samples	7
Lugol's Iodine solution (200mL bottle)	Preserve samples	1
Cooler	Store plankton samples	1
Ice Packs (large)	Preserve samples	3
Sink	Thaw plankton samples	1
Pipette (20mL) and pear	Drawing volume to concentrate subsample	1
Plastic pipette (1mL)	A. Add lugol's iodine solution to sample & B) apply samples on Sedgwick-Rafter counting cell	2
Plankton field data table	Record sample obtaining	1
Plankton lab data table	Record sample processing	1
Graduated cylinder (100mL)	Allow subsamples to settle	7
Sedgwick-Rafter counting cell and slip	Process phytoplankton samples	3-6
Digital microscope	Observe and take picture of plankton samples	1
Dichotomous key	Identify species in plankton samples	1

Field Sample Collection Process
01. Populate field data table
02. Lower set Beta bottle to 1.0m below the surface
03. Replicate for actual of 2 times
04. Pour replicate contents into 2 separate sample bottles
05. Individually mix contents of each bottle
06. Take a 100mL subsample from the well mixed bucket
07. Preserve with Lugol's Iodine preservative solution (sample settles quicker with preservative for lab steps)
08. Take an additional 100 mL subsample without preserving and add to cooler for live organism i.d.
09. Populate field data table

Lab Sample Processing
01. Take plankton sample vials out of cooler/storage
02. Place sample in a 100mL graduated cylinder and let rest for 24 hours (more if nano-plankton are present) in order for plankton to settle
03. Draw off the top exactly 90mL from the cylinder with a large (*e.g.* 20ml) pipette and pear or suction pipette (use care not to disturb cells at bottom of cylinder)
04. This gives a 10x concentration
05. Mix 10mL subsample thoroughly by swirling
06. Add Sedgwick-Rafter* counting cell to the microscope stage
07. Place cover slip** obliquely on chamber with just one corner open
08. Decant 1mL subsample carefully into the one corner with a Pasteur pipette until slip just begins to float
09. Rotate slip completely to cover chamber (this avoids introducing air bubbles into subsample)
10. Let sample stand in chamber for 15min to allow plankton to settle to the bottom
11. Count at 100x magnification and use high power if there is a need to ID small sized algal cells
12. Identify and count each taxon (that is, each species or 'type') using the steps that continue:
13. A. Count a required minimum of 30 squares by determining the squares randomly using the special plankton die (there are 50 squares across and 20 squares down) OR

B. To avoid differential settling (plankton concentrate towards the edges), as an alternative to random box counting, count a row across (traverse) of 40 boxes
14. On the lab data table record the number of grid squares counted as well as the number of algal species or 'types' counted
15. If an algal species or 'type' lies across the line engraved in the base of the counting cell so that if falls between two squares, the simple **RULE**: is that if it lies on the right side of the square grid include it in the count, but if it lies on the left side, exclude it. Similarly, if it falls across the top line of the square, include it, but exclude any algal units falling across the bottom. Algal units are often smaller than the width of the lines engraved, so the same applies for any units lying within the grid lines delineating the squares
16. The number of algal units present per 1mL within the actual water body is calculated as:

$$\text{No. of units/mL} = \frac{(\text{Units counted } \mathbf{x}\ 1000\text{mm}3)}{(\text{No. grid squares counted } \mathbf{x}\ \text{concentration factor - typically } 10)}$$

17. For filamentous and colonial units, it's necessary to convert units/mL to cells/mL. To do this, figure out how many cells in the typical colony of filament and multiply by that number. However, cyanobacteria don't have a uniform number of cells. For cyanobacteria: a. Find 30 random filaments

b. Count the number of cells in each

c. Average the amount

d. Multiply by Units to convert top cell/mL

18. If samples contain large colonies or tangled aggregations of filaments containing thousands of cells making it impossible to count take discard the sample. If the second is the same as the first, estimate a portion of the colony or aggregation – say 5% or 10% of the total colony size – and count or estimate the number of within that portion. Remember that the colonies or aggregations are three dimensional and cells will fall out of the plane of focus. Once you have an estimate of the number of cells of 5% or 10% of the colony, multiply this by 20 or 10, respectively, to obtain an estimate of the total cells per colony. This procedure can introduce large error and are indicative of a possible algal bloom and thus is only acceptable for sampling during blooms. This must be stated in results. Sonification or homogenization by chemicals is unacceptable.

*[Sedgwick-Rafter Cell – is a four sided counting chamber that is 50mm long by 20mm wide by 1mm deep, giving a bottom area of 1000mm2, and an internal volume of 1mL; they have a grid engraved on the bottom, with lines 1mm apart; if correctly calibrated and filled, the volume of sample covering each grid square is 1mm2; used on the stage of a compound microscope]

** Cover the Sedgwick-Rafter counting chamber with a thin (No. 01 thickness) cover slip

All the phytoplankton used in this research are all invertebrates. Which are preserved in iodine solution and kept overnight. Once analyzed, the phytoplankton is then disposed of.

The more phytoplankton surviving in the east river might suggest that the health is getting better. The algae that is analyzed is then cataloged, until the next sampling. The research question that this project will answer is: What type of phytoplankton is living in the Harlem and East River. If there is more than one type of species of phytoplankton thriving in the East River, then the waters conditions are getting better and there is a more wide variety of life. We hope to find a wider variety of colonies, filaments, and single celled organisms during the spring season.

The statistical design of this project are the two replicates and six treatments, two samples at the three different sites. There are three sampling days in spring 2016, three in the fall of 2015.

The objectives of this project are to determine the plankton concentration at different stations, unicellular, colonies, and filaments, compare the plankton, unicellular, colonies, and filaments, between each station; as well as compare the plankton, unicellular, colonies, and filaments, from the Harlem River and Governors Island.

The risks involved with this project is someone falling off of the boat, a sample bottle breaking, missing equipment, getting lugol's iodine on clothing or skin, if that happens scrub your hands in hot water using soap for 5 minutes. The limitations of plankton are sampling sites and the effect of not getting the correct amount of samples. The amount of sample collected at each site has a limit of 100mL per bottle.

Results:

Table 1: This is a representation of all the data collected then averaged by their aspects (Unicellular, Filamentous, Colonial phytoplankton)

Station	Unicellular Phytoplankton	Filamentous Phytoplankton	Colonial Phytoplankton
1	0	4	6
2	0	32	2.5
3	0	65	11
4	13.14	70.93	16.29

The collection of phytoplankton samples were individually analyzed by the phytoplankton team. As a result multiple diatoms were found as well as filaments and unicellular planktons. As the team analyzed each milliliter (mL) of phytoplankton was looked over and had pictures taken of certain species of phytoplankton. Some have been found in

Jamaica Bay and have been seen here in the Harlem River as reported in a study of Jamaica Bay

in 1992 (Pillias, D., Scaglione, & Tanacredi, 1992). Filaments are the most frequently showing

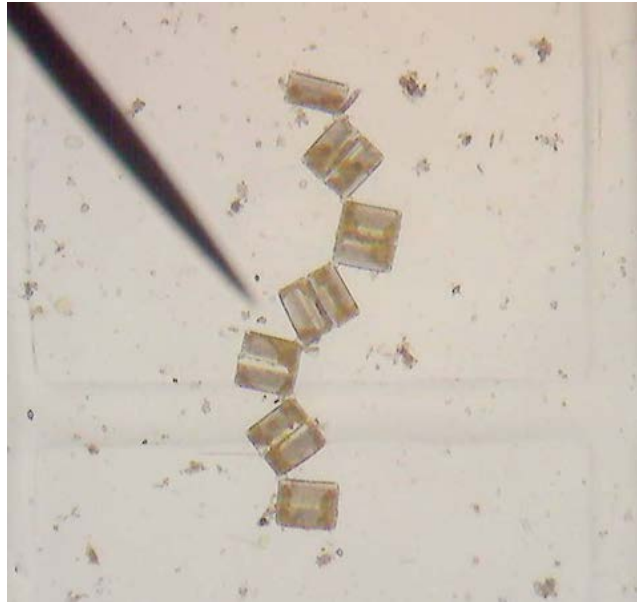phytoplankton in the samples, as well as diatoms.

Figure 1 *Tabellaria* is a zigzag colony with cells that are rectangular in shape. Its other cell form
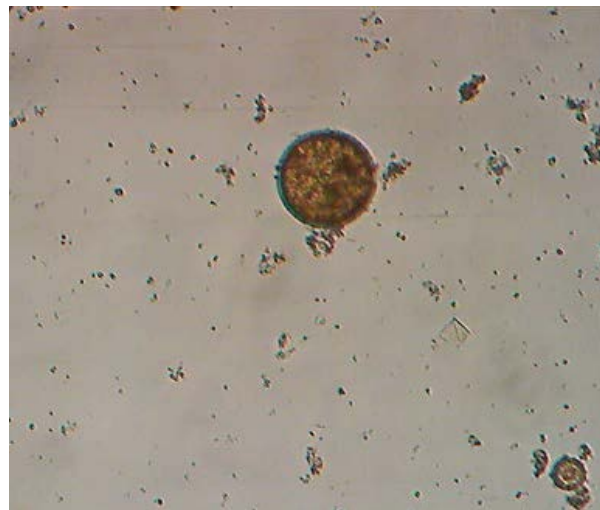looks like a unicellular form of an *Asterionella* cell.

Figure 2 *Aulacodiscus* is a circular colony. This species is one of many is the *discus* family.
And in the corner of the image there is another species called *hyalodiscus.*

Figure 3 Tentative *Chaetoceros Didymus:* This phytoplankton was found in Jamaica Bay in a previous study that focused on phytoplankton. The shape of it has a similar resemblance to that of a centipede. It also has long "whisker" like features on either side of its body. Its color is a deep red-brown shading to it.
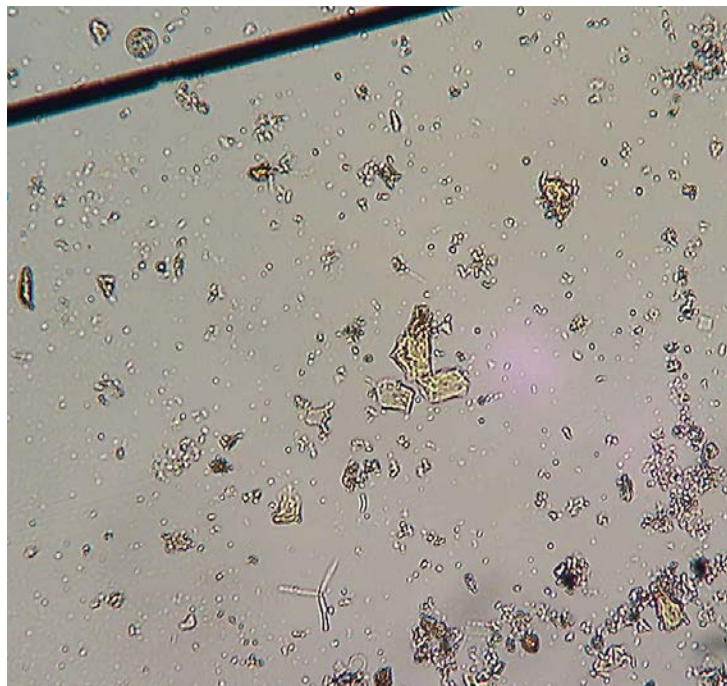

Figure 4 *Asterionella Formosa*: This phytoplankton was named after its star like shape. It's a colony that can grow to have seven or more "arms". (Bottom center of image, the pinwheel looking one) In the top left corner is another example of a *discus*.
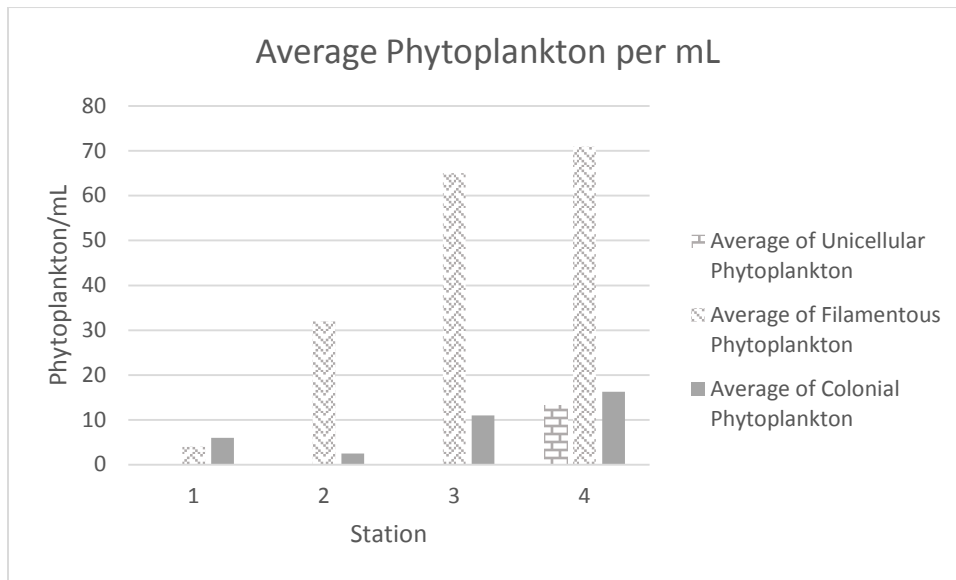
Figure 5. This graph shows the averages of phytoplankton per milliliter of unicellular, filamentous, and colonial phytoplankton from the four different sites.

Discussion:

The data collected over the year from May 2, 2015 to June 5th, 2016 have been analyzed and processed. Further sampling may be recommended. The phytoplankton that have been identified are common to the river. Some phytoplankton that have been labeled are not found in salt waters. The samples taken have had some close resemblance to that of the Jamaica Bay studies. Some of the diatoms have been either tentative to a specific phytoplankton or just one of many specific species. The data collected from each sample site shows that Governors Island has a higher average of filaments than any other group. At all the sites the group with the highest population is filamentous. There are hardly any unicellular data at any of the sites, a few colonies have been found but everything is mainly filamentous. As a separate observation this study can conclude that the control test (Governors Island) has more nutrient waters than the other sites due to the oysters being grown by the control site.

Bibliography

Pillias, J., D., P., Scaglione, A., & Tanacredi, J. T. (1992). A Photographic Inventory of Diatoms Jamaica Bay 1992. *United States Department of the Interior, National Park Service*, 28.

Garay, G. (2015, December 08). *CIVITAs Working for Quality In Urban Life*. (G. Garay, Editor, & CIVITAs) Retrieved from CIVITAs: http://civitasnyc.org/live/

Garay, G. (n.d.). *CIVITAs Working for Quality In Urban Life*. Retrieved from This Is CIVITAs: http://civitasnyc.org/live/mission-statement/

Plankton Field Data

Team:_____   Latitude:_____
Date: *10-15-16*_____   Longitude:_____
Location: *E 111 st*_____   Time: *11 34*_____
Station: *2*_____   Depth: *1 meter*_____

Weather:
Wind speed/direction:_____   Waves/tide/current:_____
Air temp: *65°*_____   % cloud: *1%*_____
Moon phase: *Waxing*_____

Water @ start:
Temperature/Salinity:_____   °C:_____ Secchi Depth:_____
pH:_____   DO:_____
Comments:

Sampling gear: *Beta Bottle*_____
a) Sample #: *101516 P2a S2* Time: *11:43*_____ Flowmeter:_____
b) Sample #: *101516 P2b S2* Time: *12:03*_____ Flowmeter:_____
c) Sample #:_____ Time:_____ Flowmeter:_____
d) Sample #:_____ Time:_____ Flowmeter:_____

Water @ end:
Temperature/Salinity:_____   °C:_____ Secchi Depth:_____
pH:_____   DO:_____
Comments:

Plankton Field Data

Team: _Phyto_
Date: _10-15-16_
Location: _E 116 st_
Station: _1_

Latitude: _____
Longitude: _____
Time: _10:24_
Depth: _1 meter_

Weather:
Wind speed/direction: _0 mph._
Air temp: _54°_
Moon phase: _Waxing_

Waves/tide/current: _Low tide_
% cloud: _1%_

Water @ start:
Temperature/Salinity: _____
pH: _7.50_
Comments:

°C: _____   Secchi Depth: _2.75_
DO: _0.6_

Sampling gear: _Beta Bottle_
a) Sample #: _10516 Pla S1_   Time: _10:30_   Flowmeter: _____
b) Sample #: _10516 Plb S1_   Time: _10:38_   Flowmeter: _____
c) Sample #: _____   Time: _____   Flowmeter: _____
d) Sample #: _____   Time: _____   Flowmeter: _____

Water @ end:
Temperature/Salinity: _____
pH: _____
Comments:

°C: _____   Secchi Depth: _____
DO: _____