Human Impacts On The Water Quality Of The Pasquotank

James L. Webb
Pharmaceutical Science
Elizabeth City State University

Ryan D. Lawrence
Political Science & Sociology
Elizabeth City State University

Amanda A. Piwowarski
Biology Pre-Medical
Elizabeth City State University

Montravias D. King
Political Science
Elizabeth City State University

Andrew Milam
Marine Ecology
Collage of the Albemarle

Shaveon Boone
Accounting
Elizabeth City State University

Lintavia Adams
Biology Pre-Medical
Elizabeth City State University

Professor Jeff Schloss
University Of New Hampshire
(Mentor)

ABSTRACT

Most people don't know that they could be contributing to adverse water quality changes right in their own backyards. How? Well because, we all live in watersheds, an area that drains to a common waterway. In order to determine how development, farmlands and water treatment plants affect water quality, we visited various locations near agriculture sites, urban development and waste treatment facilities along the Pasquotank River, the Washington Ditch, and the Great Dismal Swap in Southeastern Virginia and Northeastern North Carolina. At each location we measured of pH levels, temperature, water clarity, apparent /true color, specific conductivity, turbidity, zooplankton abundance, and the amount of chlorophyll a. We found that as we moved down river into increasing agriculture and development the water clarity decreased and conductivity increased. When we moved towards the city, "away from the swamp headwaters" dissolved color decreased and the pH increased. The lowest clarity was found in downtown Elizabeth City; we also noted that the highest chlorophyll readings were located at the sewage treatment plant. Additional water quality results supported our initial hypothesis that the quality of the water decreased with the extent of land use.

Professor Jeff, Ryan, and James preparing to go out onto the water

Introduction

Within the last decade, individuals in the scientific community as well as those in the political and public arena have begun to understand the importance of wetlands and forests in a watershed and how they contribute to the well-being of mankind, terrestrial and aquatic wildlife, and the environment. Instead of protecting them, individuals such as George Washington drained the wetlands, which had a negative impact on the overall health of that area. The wetlands and forests in a watershed, serve as a buffer from soil erosion, act as a natural filtration system, a nursery and a natural habitat for a variety of species for aquatic and terrestrial wildlife, and sustains life. According to www.loudounwildlife.org, humans, especially farmers, negatively impact the watershed by allowing hog waste and other harmful toxins to flow into inadequate drainage systems. Besides hog farms, there are agricultural farms that use and dispose of pesticides and fertilizers in ways that are detrimental to the watershed. Also, increased development increases storrmwater runoff into waters and can further load our wastewater treatment plants. It is important that we value our watershed because the presence of pollutants results and too many nutrients in the water, will ultimately affect human as it destroys our fragile ecosystem.

Montravias, Shaveon, and Andrew checking water quality

Hypothesis

As land development increases to compensate for the increase in human population, the water quality of the Pasquotank River will become worse; therefore negatively impacting various aquatic species forcing them to either adapt or become extinct.

Objective

In order to determine how development, farmlands and water treatment plants affected the water system, we visited various locations near agriculture sites, urban development and waste treatment facilities along the Pasquotank River, the Washington Ditch, and the Great Dismal Swap. Our objective was to compare impacted sites to control (unimpacted) study sites.

Methods

We sampled and compared the water quality of the Pasquotank River, Merchants Millpond State Park, Lake Drummond, and the Washington Ditch. We took the pH, dissolved oxygen percent (DO %), dissolved oxygen concentration (DO mg/L), and specific conductivity (SPC), using the YSI 85, the YSI Professional, or the YSI 625 multi-parameter meters. We calibrated each instrument before use. We measured turbidity, apparent/true color with a calibrated LaMotte Model 3001 Nephelometer/Colorimeter. Water clarity was measured using the Secchi disc on the river and lake and using a clarity tube on-shore. Shore measurements were taken at ½ meters depth. Depending on depth or the river or lake, we took measurements at 0.1 meters, ½ meters, 1 meter, 2 meters, 3 meters, and 4 meters, and averaged all readings from 0.1 to 2.0 meters for comparison. Afterwards, we used the Leica Zoom 2000 dissecting microscope to identify the different species of zooplankton using the UNH CFB key. Finally, we recorded and analyzed our data in Microsoft Excel and created summary statistics and graphs to illustrate the differences in the various testing sites.

Results

As we moved down the Pasquotank River conductivity and pH increased and color (both apparent and dissolved) and water clarity decreased (see table below). The highest chlorophyll concentration and dissolved oxygen concentration (and percent) was found below the Waste Water Treatment Plant (WWTP). The most zooplankton were found at the wooded section of the river we used as a control site. The least were found below the WWTP. Surprisingly, turbidity decreased as we progressed down the river.
Washington Ditch Pond water had lower oxygen, color, and conductivity than Lake Drummond. It also had much less zooplankton abundance. The pH of the ditch pond and the water clarity was higher than the lake. Merchants Mill Pond had a pH, conductivity and color that fell between the other two swamp sites. It did have a much lower oxygen level than any of the sites we sampled.

Pasquotank River Data Comparison Summary												
Site	Temperatue	ph	DO%	DO mg/l	Conductivity	turbidity	color	true color	clarity	Chl	Zoop. Abund	Dominant/Others
	C	units	percent	mg/L	uS	NTU	PTU	PTU	cm	ppb	relative	
Pasquotank River Control site	29.4	6.0	55.7	4.2	1375.5	4.0	324.0	297.0	136.0	7.9	High	nauplii, few bosmina
Pasquotank River Agriculture ditch	30.2	6.1	56.4	4.2	1517.3	4.0	300.0	247.0	25.0	8.3	Low	Copepods, bosmina
Pasquotank River above STP* (unaffected)	30.6	6.3	75.0	5.5	2298.0	3.6	224.0	204.0	50.0	7.7	Medium	Copepods
Pasquotank River below STP (affected)	30.5	6.4	77.3	5.8	2490.3	3.5	205.0	188.0	48.6	10.5	Very Low	no zooplankton
Pasquotank River at Elizabeth City	29.0	6.4	71.7	5.5	3184.5	NS	NS	NS	25.4			
Dismal Swamp Comparison summary												
Site	Temperatue	ph	DO%	DO mg/l	Conductivity	turbidity	color	true color	clarity	Chl	Zoop. Abund	Dominant/Others
Washington Ditch 1st Culvert	22.4	5.4	60.5	5.3	83.5	7.7	76.9	64.1	44.7	9.2	Low	None, Dragonfly larvae,
Washington Ditch 2nd Culvert	22.5	5.8	64.8	5.6	89.8	7.7			44.7			
Merchants Millpond	26.9	6.1	33.0	3.9	88.2	6.8	110.7	84.0	41.5	7.1	High	Cyclopoids
Lake Drummond end of pier	30.5	4.4	48.3	3.5	107.4	15.5	321	294.3	20.0		Very High	Cyclopoid, Rotifers,Bosmina
Lake Drummun start of pier	35.9	4.4	98.7	6.6	128.0	15.5			20.0	8.0		
Lake Drummun middle of pier	34.5	4.3	75.2	5.0	114.1	15.5			20.0			
* Sewage Treatment Plant												

Professor Jeff and Amanda collecting a water sample from the Pasquotank River

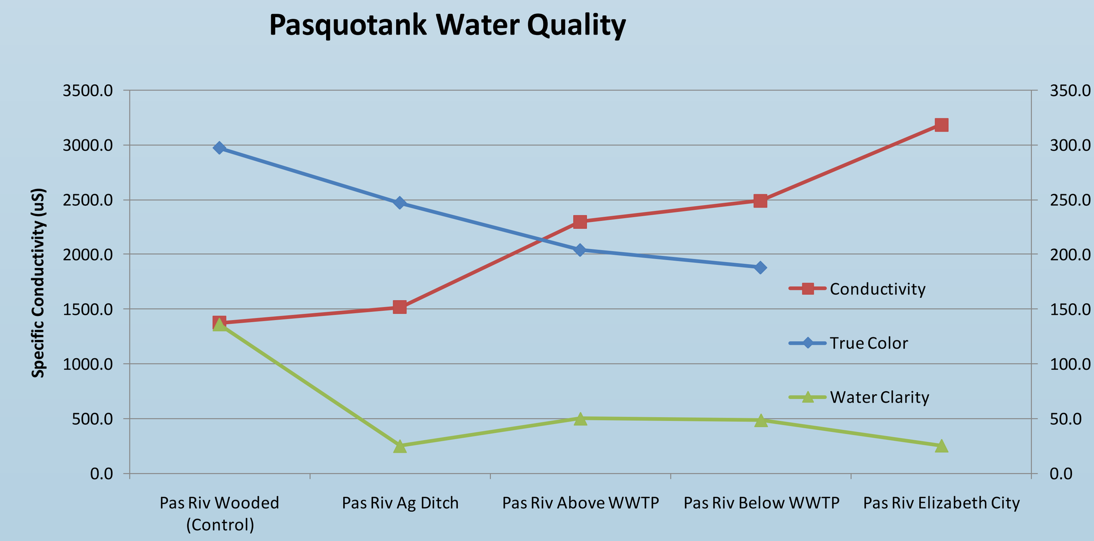
Discussion

We found that as we moved down the river into increasing agriculture and development the water clarity decreased and conductivity increased. This follows as these land use activities have the potential to add sediment, fertilizers, and pollutants in the storm runoff. When we moved down river from the headwater swamps the dissolved color decreased and pH increased as the lower section of the river collects runoff from upland areas, farms and developments. The lowest clarity was found at downtown Elizabeth City a highly urbanized area that contributes more runoff due to lack of vegetated buffers. We also noted the highest chlorophyll levels and highest oxygen below the WWTP. WWTPs often pump air into their treated waters to allow for the cleaning process to work efficiently but more nutrients are most likely entering the water from the plant. The lowest two sites for zooplankton were the agricultural ditch and the sewage treatment plant which suggests some toxins may be present. Lake Drummond had low pH, very high color, and the lowest water clarity but had a very healthy zooplankton community. So while it is an extreme environment the organisms have adapted and it is not highly impacted by land use. The lower oxygen level at Merchant Mill Pond was most likely due to the bloom of duckweed and watermeal blocking sunlight into the water.

Cyclopoid Copepod

Rotifer

Map showing locations of our sampling sites at the Great Dismal Swamp and the Pasquotank River



References
Environmental Protection Agency: Office of Wetlands Oceans and Watersheds. (August 5th 2009) Retrieved from http://www.epa.gov/owow on 10th for 2009.
Loudoun wildlife Conservancy: Watershed fact sheet. (August 8th 2009) Retrieved from http://www.loudounwildlife.org on 10th August 2009.
Stream Team: Conductivity/ total dissolved solids. (2004) Retrieved from (http://www.stream-team.org/Parameters/conductb.html on 10th August 2009.
Smithsonian National Zoological Park: Environmental Monitoring Laboratory. (2009) Retrieved from http://nationalzoo.si.edu/Education/CommunityOutreach/ColumbiaHeights/Water_Quality/default.cfm on 10th August 2009.
The University of New Hampshire: An Image-Based Key To The Zooplankton Of The Northeast (USA). (2009). Retrieved from http://www.cfb.unh.edu/CFBKey/html/index.html on 10th August 2009.
Professor Jeffrey Schloss. Personal Communication.

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