Climate Change and Its Effects on Virginia's Wildlife and Water Supplies

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Introduction

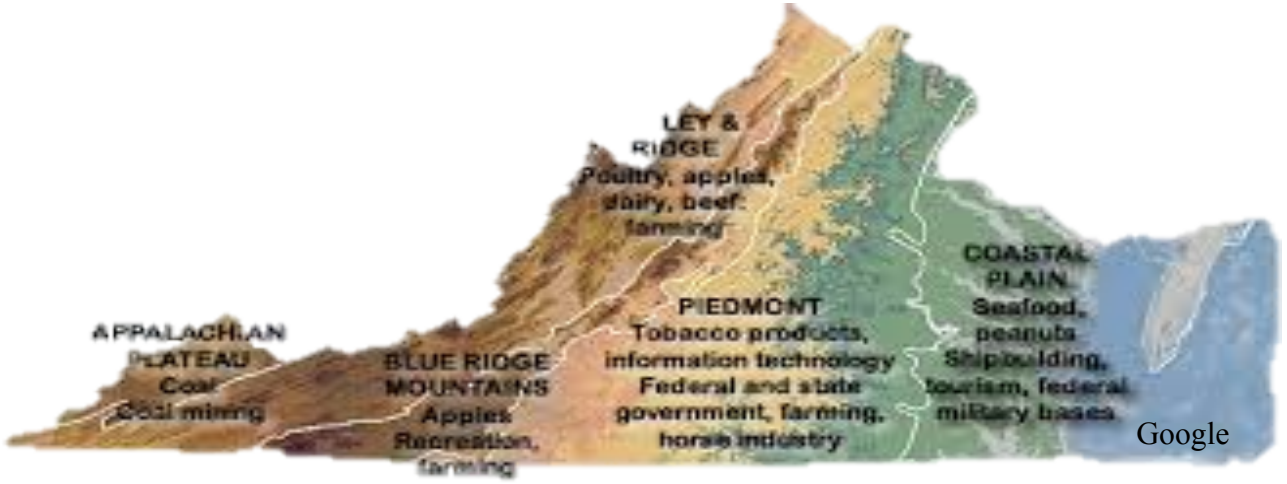
- Global climate change has greatly changed throughout the history of Earth.
- In Earth's atmosphere, there are many greenhouse gases such as carbon dioxide, nitrous oxide and methane that absorb and emits heat. Without these gases, Earth would be frozen.
- Due to human activities such as use of transportation, burning of fossil fuels and farming, the green house gases are increasing. As a result, the Earth is becoming warmer (global warming).
- This warming of the Earth's surface and rising levels of greenhouse gases are detrimental and is causing a huge change in climate.
- According to NASA, some observed changes in climate include:
  - Sea level has risen 7 inches
  - Carbon dioxide levels are up 409 ppm (parts per million)
  - Temperature has increased by 1.8 °F since 1880
  - Earth's polar ice sheets are at 413 giagatonnes per year (low mass)

What does this mean for water and wildlife?

- Water is essential for humans to live. We drink it, cook with it and bathe with it.
- Therefore, due to global climate change, our drinking water will be contaminated.
- Some possible effects include:
  - Contaminated drinking water due to too much water from polar ice caps melting.
  - Groundwater water supplies can be contaminated with saltwater from risen sea-levels
- Wildlife can usually adapt to change, but with global climate change happening so rapidly, the wildlife are finding it hard to keep up.
- Some effects of global climate change that are detrimental to wildlife include:
  - Increased temperature
  - Polar ice caps melting (Polar bears dying)

Virginia's Climate

- Virginia is the only state with five distinct climate regions: Coastal, Piedmont, Blue Ridge, Valley & Ridge and the Appalachian Plateau. Because of the different topographic regions and the Atlantic Ocean, climate change varies greatly in Virginia.
- Because of this and global climate change, Virginia's wildlife and water supplies are effected tremendously.



Climate Change and Its Effects on Virginia's Water Supplies

Photo credit: Virginia Dept of Game and Inland Fisheries/ Alan Weaver

- The Appomattox River, a tributary of the James River, stretches from Lake Chesdin to Hopewell Point and ultimately joins with Chesapeake Bay.
- It is an important source of drinking water for Dinwiddie, Petersburg, and Colonial Heights and is home to many species of fish, including bass, bluegills, and more. .
- The Appomattox River is not studied as much as other Virginia rivers (such as the Potomac-Shenandoah River system, the Rappahannock River, the York River, and the James River.) where geotagging the sites for water quality monitoring is done concurrently.

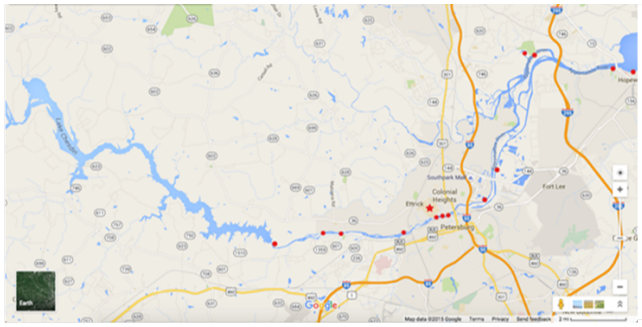
What is the purpose of studying the Appomattox River?

- The Appomattox River is just one body of water that eventually flows into the Chesapeake Bay. Therefore, if there is an abundant amount of contamination in the Appomattox River, there is also in the Chesapeake Bay.
- The purpose of this project is to monitor the quality of the water at selected locations of Appomattox River.
- The hypothesis of this study is that the water quality of the Appomattox River be monitored for pollution by:
  - Measuring the physical parameters (e.g. nutrients, turbidity, and dissolved oxygen)
  - Contamination of water by assaying the pathogenic strains of Escherichia coli (E. coli) for safety of aquatic organisms and human health.

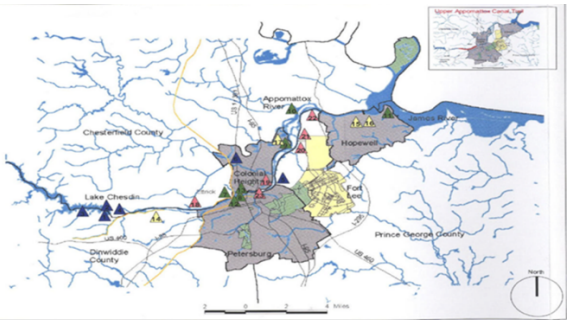
Water Quality

- Water quality is determined by a complex amount of factors which must be measured simultaneously as well as at various locations to begin to identify sources of pollution or other threats.
- In order to do this, water samples were collected at various locations along the Appomattox River during Fall 2016 and Spring 2017. These locations were: Lake Chesdin, Petersburg, Colonial Heights, Hopewell, and Randolph Farm of Virginia State University which is located between Petersburg and Colonial Heights.
- At these locations, the data on geographical locations, as well as pictures of study sites were collected with GPS.

Geotagging and Water Collection Sites



Sites where water samples were collected for water quality measurements and GPS data for geotagging the study sites



Map showing study sites along Appomattox River

Randolph Farm

Virginia State University Campus

Methods for Water Quality Testing

- Three water samples were collected from each site in 500 ml plastic bottles. Water and Air Temperatures, Turbidity and Dissolved Oxygen were measured on-site from the sample, while the rest was transported back to Enviromental Science Lab at VSU for measurements of other parameters.

Student, Latia Jackson collecting water sample from Appomattox River near VSU campus

Students taking readings which include GPS points at the Appomattox River near VSU campus

What was tested?

- Temperature: to see if it is warmer than usual (sea level rise)
- Dissolved Oxygen: helps marine wildlife breathe and plants photosynthesize
- Turbidity: suspended sediment that blocks light
- pH: acidity harms marine wildlife (range of pH for wildlife and plants)
- Hardness: dissolved calcium and magnesium; hard water (leaves residues) and soft water (sodium only)

Results- Fall 2016

	pH	DO%	Turbidity	Hardness	Temperature
11/8/2016 Exit #1 On Campus	0	86.4	0	0	11.7
11/8/2016 #2 Gateway Bridge	0	86.4	0	0	14.8
11/8/2016 #3 Back Entance VSU	0	80	0	0	14.2
11/8/2016 #4 Farm Entrance	0	63.1	0	0	12.9
11/8/2016 #5 Farm Middle	0	40.9	0	0	12.9
11/8/2016 #6 Farm End	0	81.4	0	0	13.2
11/9/2016 Exit #1 On Campus	0	77	5.8	119.7	14.1
11/9/2016 #2 Gateway Bridge	0	9	1.44	119.7	15.2
11/9/2016 #3 Back Entrance VSU	0	10.4	1.93	102.6	14.3
11/9/2016 #4 Farm Entrance	0	7.01	777	34.2	13.7
11/9/2016 #5 Farm Middle	0	67.1	7.9	34.2	13.6
11/9/2016 #6 Farm End	0	93.2	4.27	34.2	13.8
11/11/2016 Exit #1 On Campus	7	100	15.8	68.4	13.9
11/11/2016 #2 Gateway Bridge	7	84.5	4.15	85.5	14.7
11/11/2016 #3 Back Entrance VSU	7	95.6	1.64	68.4	13
11/11/2016 #4 Farm Entance	6.5	56.5	122	102.6	12.8
11/11/2016 #5 Farm Middle	6.5	41.3	6.99	34.2	13
11/11/2016 #6 Farm End	6.5	90.1	0.45	34.2	13.6
12/5/2016 Exit #1 On Campus	0	70.6	0	51.3	10.7
12/5/2016 #2 Gateway Bridge	0	94.4	0	85.5	12
12/5/2016 #3 Back Entrance VSU	0	92	0	85.5	11.6
12/5/2016 #4 Farm Entrance	0	69	0	51.3	9.8
12/5/2015 #5 Farm Middle	0	49.2	0	51.3	10.8
12/5/2016 #6 Farm End	0	91.7	0	34.2	10.5
12/13/2016 Exit #1 On Campus	0	74.5	11.03	68.4	9.7
12/13/2016 #2 Gateway Bridge	0	87	8.13	68.4	10.6
12/13/2016 #3 Back Entrance VSU	0	91.2	6.73	85.5	10.1
12/13/2016 #4 Farm Entrance	0	69.3	15	51.3	9.9
12/13/2016 #5 Farm Middle	0	65	10.03	51.3	9.8
12/13/2016 #6 Farm End	0	83.4	5.24	34.2	9.6

Results- Spring 2017

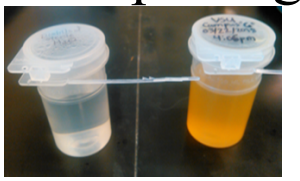
	pH	DO%	Turbidity	Hardness	Temperature
2/10/2017Exit #1- On Campus	7	81.5	7.42	53.5	7
2/10/2017#2 Gateway Bridge	7	108.1	5.5	52.5	7.4
2/10/2017#3 Back Entrance VSU	7	102.01	11.2	51.8	6.8
2/22/2017# 4 Farm Entrance	5.5	83.2	113	53.6	6.3
2/22/2017#5 Farm Middle	6	94.4	36.3	53.6	7.4
2/22/2017#6 Farm End	6	91.5	326.6	52.5	6.8
3/2/2017Exit #1- On Campus	7	88	30.6	51.3	7.6
3/2/2017#2 Gateway Bridge	6.5	96.5	11.1	51.3	8.1
3/2/2017#3 Back Entrance VSU	6.5	104.1	10.42	85.5	8
3/20/2017# 4 Farm Entrance	6.6	83.4	129	Error	6.5
3/20/2017#5 Farm Middle	6	97.7	93.3	34.2	8
3/20/2017#6 Farm End	6	88	16.1	34.2	8.3
4/2/2017Exit #1- On Campus	7	105.6	11.45	34.2	8.9
4/2/2017#2 Gateway Bridge	7	106.2	6.99	34.2	9.1
4/2/2017#3 Back Entrance VSU	6.5	103.2	14.8	34.2	8.7
4/14/2017# 4 Farm Entrance	6	78.2	98	51.3	8.3
4/14/2017#5 Farm Middle	6	91.5	107.1	34.2	10.9
4/14/2017#6 Farm End	6	92.4	32.9	34.2	9.4

* 0 indicates that this water quality parameter was not tested due to a low abundance of equipment or little to no data

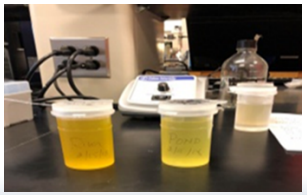
Methods for measuring E.coli and coliform bacteria

1. Colitag: (testing to see if bacteria are present)

2. 100mL of water samples was transferred into a sterile bottle on the flat surface of laboratory counter and one package of Colitag was added to this sample bottle.

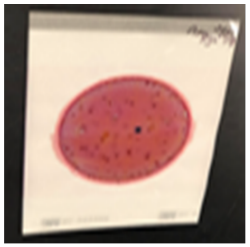


3. This bottle was shaken until Colitag was dissolved in this bottle with the sample and placed in the Incubator set at 30-33 degrees Celsius for incubation overnight.



Results

- 3M Petrifilm EC Plates E. coli colonies present after incubation
- Few E-coli colonies on undiluted samples indicate that there was contamination at the sites visited


Discussion

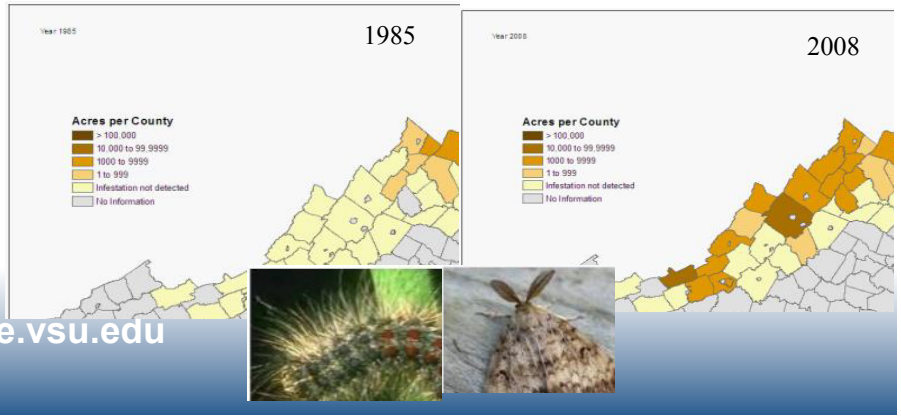
- There were no significant variation between sites, yet there were differences in the water hardness. The pH measurements showed no appreciable differences between sites. This is a on going research project. Further research in Fall 2018 will be used as a comparison to collected data.

Climate Change and Its Effect on Virginia's Wildlife

- The Virginia's Strategy for Safeguarding Species of Greatest Conservation Need from the Effects of Climate Change says "Virginia's wildlife faces daunting challenges… Unfortunately, climate change is likely to add another suite of stresses to Virginia's habitats, exacerbating the existing issues, and making it that much more difficult to preserve Virginia's wildlife heritage".
- Some of the major effects include:
  - ❖ Loss and degradation of habitats due to deforestation
  - ❖ Rising air force mountain wildlife into higher elevations
  - ❖ Precipitation patterns
  - ❖ Floods
  - ❖ Sea-level rise
  - ❖ Drought
  - ❖ Fluctuations in water temperatures
  - ❖ Water quality (pollution)
  - ❖ Change in weather (hurricanes and storms) hard for species to adapt

Gypsum Moths (Lymantria dispar) Defoliation 1985-2008

- According to William and Mary (VMS), some climate related factors which are thought to influence the gypsy moth distributions:
  - Increase in Air temperature
  - Tree species distribution (related to air temperature and precipitation)
  - Tree/leaf growth (related to air temperature and precipitation)
  - Leaf nitrogen concentration (related to atmospheric CO2 concentrations, predicted to decrease)
- For the past 30+ years, gypsy moths have been diminishing due to climate change. Because gypsy moths mate and reproduce, they need both warm and cold climates. The warmer climate is when they actually mate and lay eggs and the cooler climate is the time the egg uses to develop (VMS). Since the Earth is gradually heating, gypsy moths are no longer going to be able to reproduce developed moths.



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