Apalachicola River Basin

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ACF Basin Profile

The Apalachicola-Chattahoochee-Flint (ACF) basin is the site where three rivers drain into the Gulf of Mexico. It is the endpoint of a river system that is 550 miles long, and has a 19,600 mile watershed that starts as the Chattahoochee River in the Smokey Mountains. The southernmost section of this river system is the Apalachicola River which is 106 miles long and drains into a flood plain of about 2,400 miles (Couch, 2016). The river's average discharge is about 26,000 ft3/s into the Apalachicola Bay (Couch, 2016). The river system, its basin, and the bay it drains into, are all an incredibly valuable system. The area is a biodiversity hotspot, an extremely valuable economic commodity, and the center of many people's lives.

The upper limit of the Apalachicola River is the Jim Woodruff Dam (Figure 1), found one mile downstream from the spot where the Chattahoochee and Flint River join (Elder, Flagg, Mattraw, 1988). The main headwater inflow of the river comes from Lake Seminole, the body of water impounded by the dam. The main tributary of the Apalachicola is the Chipola River (Elder, Flagg, Mattraw, 1988).

The sediments of the river basin consists mainly of Holocene age material, with late Pleistocene sediments being found near the mouth of the river (Elder, Flagg, Mattraw, 1988). The river bed is made up of Pleistocene deposits that is mainly sand and coarse gravel (Elder, Flagg, Mattraw, 1988). Sands and clays have been deposited by river flow over time as well. The flood plain soil has a diverse range of textures because of the large amount of sediments that have been washed down the river and now make it up (Elder, Flagg, Mattraw, 1988). The flood plain soil is mostly made up of clay, silty clay, and clay loam (Elder, Flagg, Mattraw, 1988). The sand found on bars within the river tend to be very fine and are mostly micaceous type, this is different from the majority of other sands found in Florida which tend to be siliceous (Elder, Flagg, Mattraw, 1988).

The average rainfall in the river basin is around 58 inches a year, this is combined with an average rainfall of 52 inches in the Flint and Chattahoochee river basin, the main tributary of the Apalachicola (Elder, Flagg, Mattraw, 1988). The Apalachicola depends mostly on the average rainfall from the Georgia side of the river system (Elder, Flagg, Mattraw, 1988). This is due to the fact that only a small percentage of the river system comes from Florida. The lower portion of the river however, does depend more on Florida rain flow (Elder, Flagg, Mattraw, 1988).

The headwaters of the Apalachicola near the Chattahoochee river has a mean flow of about 22,300 ft 3/s. A low mean flow would be considered around 10,000 ft 3/s and a high mean flow would be around 100,000 ft 3/s (Elder, Flagg, Mattraw, 1988). Overall the flow of the river increases as the river flows southward (Elder, Flagg, Mattraw, 1988). Flow readings were taken in the field with one flow reading in March near the Jim Woodruff Dam at the start of the river being 12,100cfs. Further south another flow reading was taken near Bristol Florida in April and the flow was around 20,000cfs.

The height of the river varies depending on the time of the year and the amount of rainfall happening at that time of the year. The river is typically at its lowest around late summer into fall, during this time it just rises over the floodplain slough, barely reaching lowland swamp forests (Tonsmeire, Fig. 9). The average flow of the river is seen in late Spring into early summer, during this time swamps within the flood plain are inundated but higher up bottomland forests are still relatively dry (Tonsmeire, Fig. 11). High flow happens in late winter and early spring, during these times of high river flow the entire floodplain, even upper bottomland forests are completely inundated with water (Tonsmeire, Fig 14). For a more concise view on river flow see Figure 2.

The Apalachicola River system is one of the most biodiverse ecosystems in the United States (Tonsmeire, Fig. 7). Its high percentage of endemic species are related to its unique geology and topography. For example one of the rarest coniferous trees in the Western hemisphere, the Torreya Tree (***Torreya taxifolia)*** is found only in a small stretch along the river, in the unique steephead ecosystems (torreyaguardians.org). On top of the large amount of endemic species the river system is invaluable as a nursery type ecosystem. Countless animal species raise their young around this river, taking advantage of the many calm pools to rear and develop young. The river basin is also very well forested containing a combination of swamp, low bottomland, and high bottomland forest, dominated by tupelo, cypress and other hardwood trees (Elder, Flagg, Mattraw, 1988).

For the thousands of people who live along this river it is a vital source of revenue. Apalachicola Bay is the site of a very valuable shellfish industry which is completely reliant on the unique flow and geography of the river. Additionally, the river has been used as a transportation hub, barging is used frequently to transport goods and resources up and down river (Elder, Flagg, Mattraw, 1988). Other industries that are reliant on the river include agriculture, and timber harvesting (Elder, Flagg, Mattraw, 1988).

The Apalachicola River is at the forefront of a three state battle for water. The ACF basin falls in three states: Georgia, Alabama, and Florida. All three states draw from the river basin for their own reasons. Georgia needs water to help large metropolitan areas like Atlanta grow (southernenvironment.org). Alabama needs water to help supply its large agricultural industry (southernenvironment.org). Florida needs the continued flow of freshwater to help support the fisheries that need an influx of freshwater (southernenvironment.org). Both Alabama and Georgia have dammed sections of the ACF basin for their own needs which has greatly affected the health of both the Apalachicola River system, and Apalachicola bay. The limited river flow effects habitat within the basin by taking away the necessary flooding that maintains the unique habitats found along the river (southernenvironment.org). The lack of fresh water being brought in by the Apalachicola River also effects the oyster productivity of Apalachicola Bay by limiting the freshwater inflow that's necessary for oyster growth.

The Apalachicola River system is a biologically unique region, possessing both unique species and habitats. Additionally it is a valuable economic commodity providing jobs and revenue to the surrounding area. Both its economic value and biological value are dependent on so many factors that need to be kept in balance. If a proper flow rate isn't achieved then the valuable flood plain ecosystems can't survive and the shellfish industry further downstream isn't able to thrive either. Both this unique ecological region, and revenue source are at risk because of the actions of the users of its tributary upstream. In order to protect the incredibly valuable resource that is the Apalachicola River it is imperative to fight for not only its best interests but for the best interests of the people that rely on it.

Studying the ACF

Introduction

In order to gain a better understanding of this biodiverse region, a number of tests were performed to gain more knowledge about the river system. In particular the human effect on the river and how water characteristics change the further down the river you go was examined.

Using a YSI kit we measured Total Dissolve Solids and conductivity of each site, both Total Dissolve Solids and conductivity are indicators of water quality. Conductivity is the measure of the capability of a solution to carry an electric current which is an indicator of the concentration of dissolved electrolyte ions in the water (fosc.org). A measurement of Total Dissolve Solids (TDS) is also a good measure of water quality, like conductivity a spike in TDS A significant increase in conductivity could indicate a discharge of pollutants in a water system (tdsmeter.com, 2012).

Additional arsenic sampling was also done at the Jim Woodruff Dam site, near a lined coal ash pit to create an arsenic profile for the river system and the surrounding sediments. This profile was created to be a baseline measurement to be used to monitor potential future arsenic contamination.

Methods

A YSI kit was deployed at two different sites: one near the start of the Apalachicola river on the south side of the Jim Woodruff dam, and another further downstream near Bristol Florida. The YSI was deployed at low, intermediate, and deeper depths to get an accurate depiction of the water profile. Water samples were also collected at three different spots on the river: close to shore, close to the middle of the river, and above the coal site in the middle of the river nicknamed "the plant." These collected water samples were than taken to be tested for arsenic with a mass spectrometer. Sediment cores were also taken at distances of 2 feet and 5'10" from the water's edge. They were analyzed for arsenic concentration at 3 distinct depths.

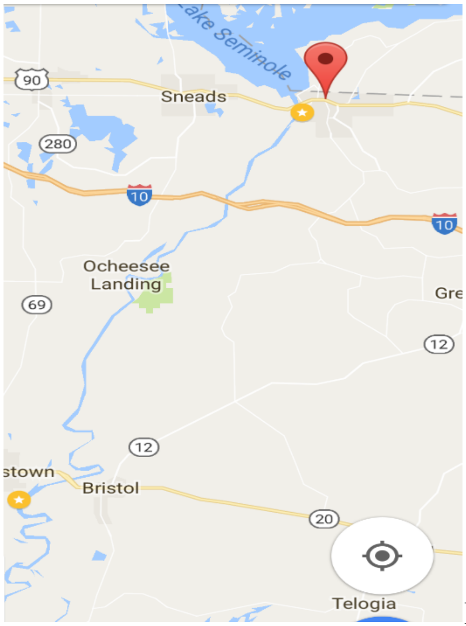

Figure 9: Starred areas represent sampling points.

Results

It was found that both total conductivity and the TDS were lower at the Bristol Site then they were at the Jim Woodruff dam site (Figure 3 and4). This meant that as the river flowed downstream its conductivity and amount of total dissolved solids decreased.

It was also found that the mean amount of arsenic concentration was highest in the sediment core samples taken two feet away from the river's edge, it was lowest in water samples taken from the river (Figure 8). Within the water samples the arsenic concentration was highest at the water sampling site above the coal plant (Figure 7).

Water quality Testing

Conductivity

Jim Woodruff Dam Site

Depth at Which Sample Was Taken in Feet	Conductivity in Microsiemens
0	131.9
5.5	128.2
20	128.4

Bristol Site

Depth at Which Sample Was Taken in Feet	Conductivity in Microsiemens
0	108
9.3	103.1
11	102.3

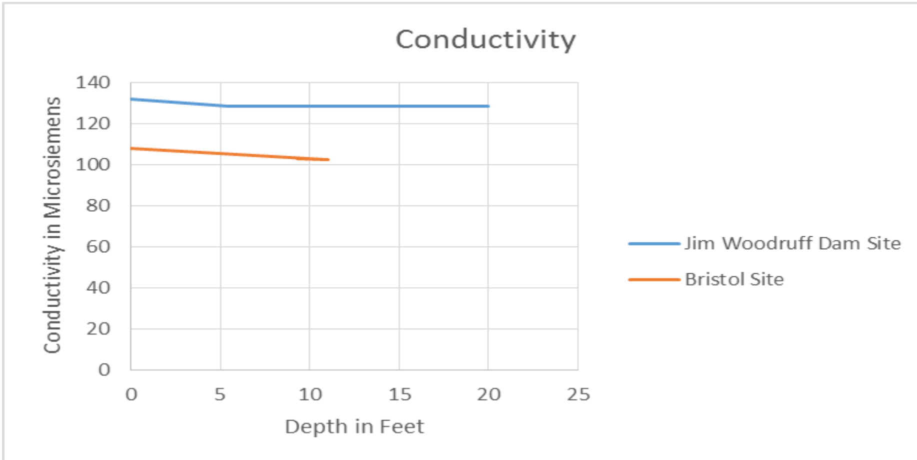

Figure 3.

Total Dissolved Solids (TDS)

Jim Woodruff Dam Site

Depth at Which Sample Was Taken in Feet	Total Dissolved Solids in mg/L
0	86.7
5.5	83.4
20	83.5

Bristol Site

Depth at Which Sample Was Taken in Feet	Total Dissolved Solids in mg/L
0	72.1
9.3	70.5
11	69.6

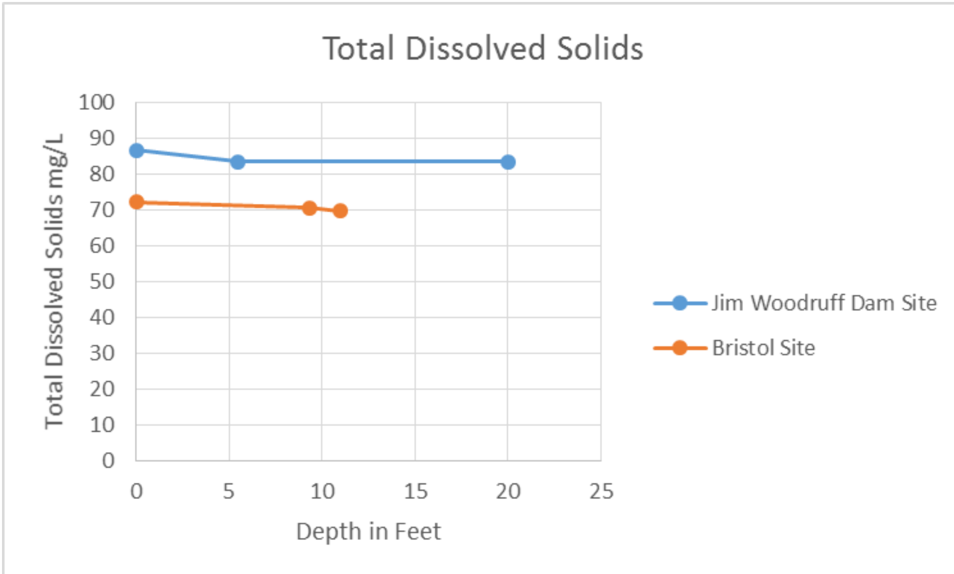

Figure 4.

Arsenic Measuring

Sediment Core Sample Taken 2 Feet from Water's Edge

Depth Core was Measured	0-2cm	2-4cm	4-6cm
Arsenic Concentration in ppm	60.68	52.07	64.14

Arsenic Concentration in ppm	60.22	63.23	64.51
Arsenic Concentration in ppm	71.04	68.18	63.57
Mean Concentration	65.63	61.16	64.07
Total Mean Arsenic Concentration in ppm	63.62		

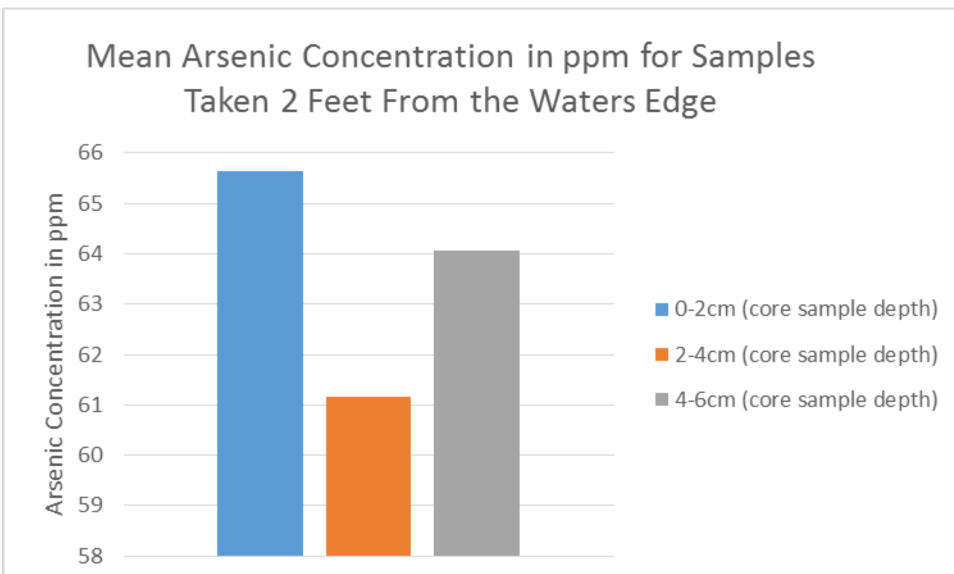

Figure 5

Sediment Core Sample taken 5'10" from Water's Edge

Depth Core was Measured	0-2cm	2-4cm	4-6cm
Arsenic Concentration in ppm	60.69	55.11	63.07

Arsenic Concentration in ppm	58.04	60.47	50.54
Mean Concentration	59.47	57.79	56.81
Total Mean Arsenic Concentration in ppm	58.02		

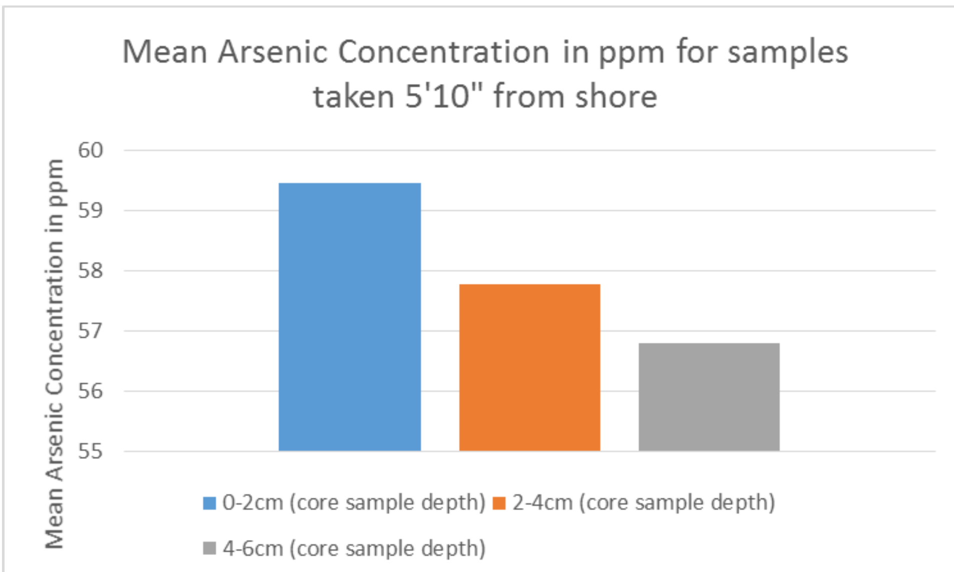

Figure 6.

Arsenic Concentration Taken From the River

Water Level That Samples Were Taken At	Near Shore	Middle of River	Above Plant

Arsenic Concentration in ppb	2.628	2.547	2.822
Arsenic Concentration in ppb	2.531	2.525	2.523
Mean Concentration in ppb	2.5795	2.536	2.6725
Total Mean Arsenic Concentration in ppb	2.596	Total Mean Arsenic Concentration Converted to ppm	0.002596

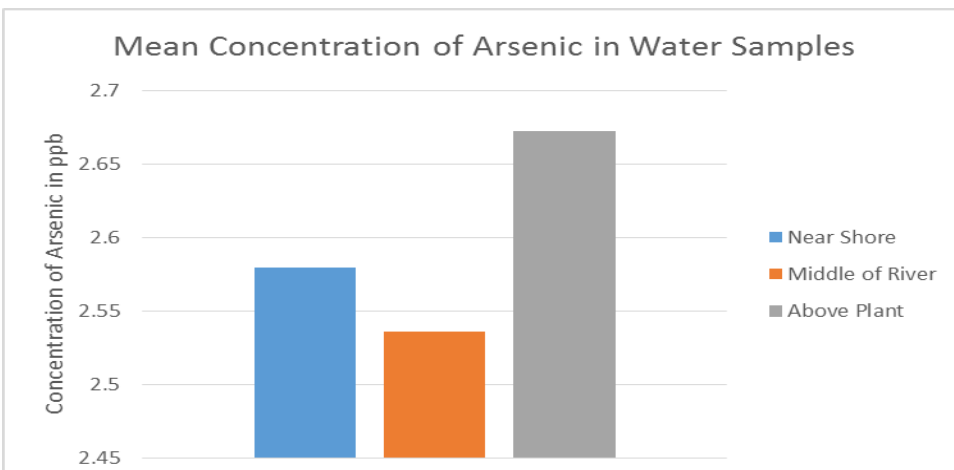

Figure 7

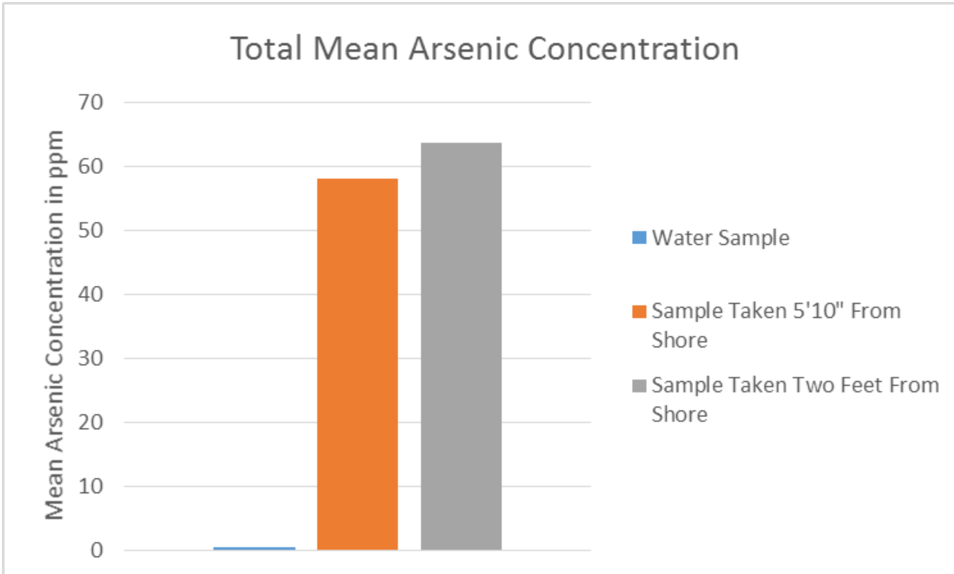

Figure 8

Discussion

The fact that conductivity and concentration of TDS got lower the further downstream that samples were taken could possibly indicate that the heavily forested surrounding of the ACF basin did a good job filtering out additives that could've potentially been added to the river system, as well as filtering out additives that were already in the water system. It could also potentially show that the types of human activity that would add dissolved solids, such as agriculture doesn't have as much of an effect on river water quality. Additional tests should be done even further downstream to see if the conductivity and TDS decline even more or if they experience a spike around certain, more developed, regions.

The arsenic concentration showed that most of the arsenic in the system leaches into sediment closest to the river. Sediment overall, will take up much more arsenic than water will (Figure 8). This could, however be problematic because the water can get contaminated with arsenic significantly easier if it is flowing over sediment that has a high concentration of arsenic, this could lead to a higher concentration of arsenic leaching into the water.

Also, the water sampling site with highest amount of arsenic contamination was the site above the coal plant (Figure 7). This could indicate that that is a point source of arsenic release. It is possible that the arsenic is released into the river, leaches into the sediment, and is stored in the sediment until more water pulls it from the sediment. Monitoring should be done in the future to see if the concentration of arsenic rises because of this. This monitoring should consist of water sampling at different depth to see if the where the arsenic is most present. Sediment cores should also be analyzed to see how much is being stored in the river sediment over time.

There was a high chance for error throughout the sampling process. There were many people sharing data and collecting samples so there is the high probability that a human error could've been made in the gathering of this data.

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Figures

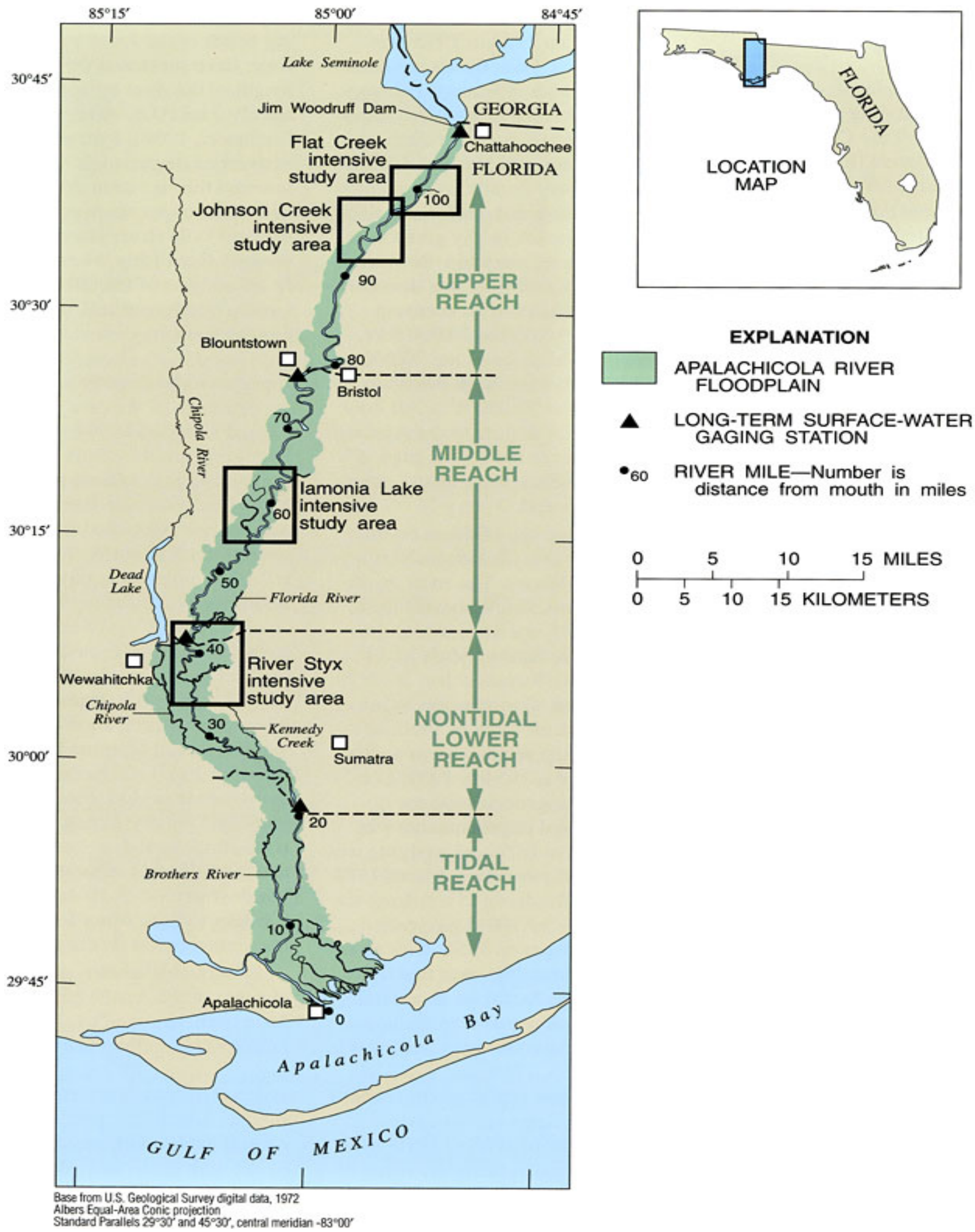

Figure 1. (http://fcit.usf.edu/florida/maps/pages/9100/f9113/f9113.htm)

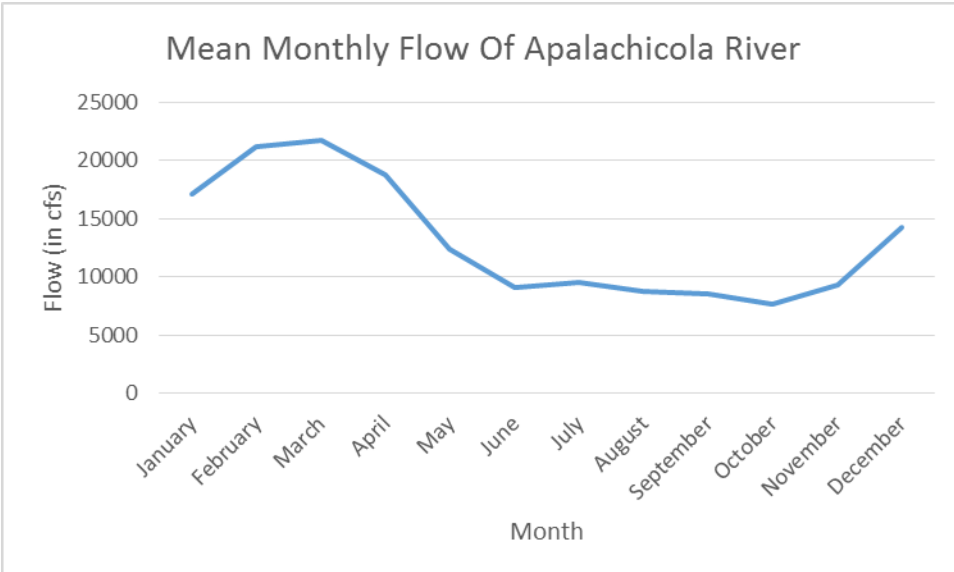

Figure 2

Data used was from ATKINS report