



Aquatic Salamander Sampling at Jug Bay

By- Mady Rhoades



A little about me

- I am going into my senior year at West Virginia University
- I study wildlife and fisheries management with a minor in forestry
- After graduation I plan to pursue a masters degree
- I grew up in Edgewater, MD and grew up going to Jug Bay and attend summer camp
- I have always had a love for the outdoors and all critters I could find





Importance of salamanders

- Salamanders are an environmental indicator, meaning their presence or absence can tell you about the quality of a habitat
- Sampling salamanders can be very difficult because they are cryptic in nature and can be fossorial (spending part of their lives underground)
- Globally salamander species have been declining, making knowledge and conservation of their species even more important

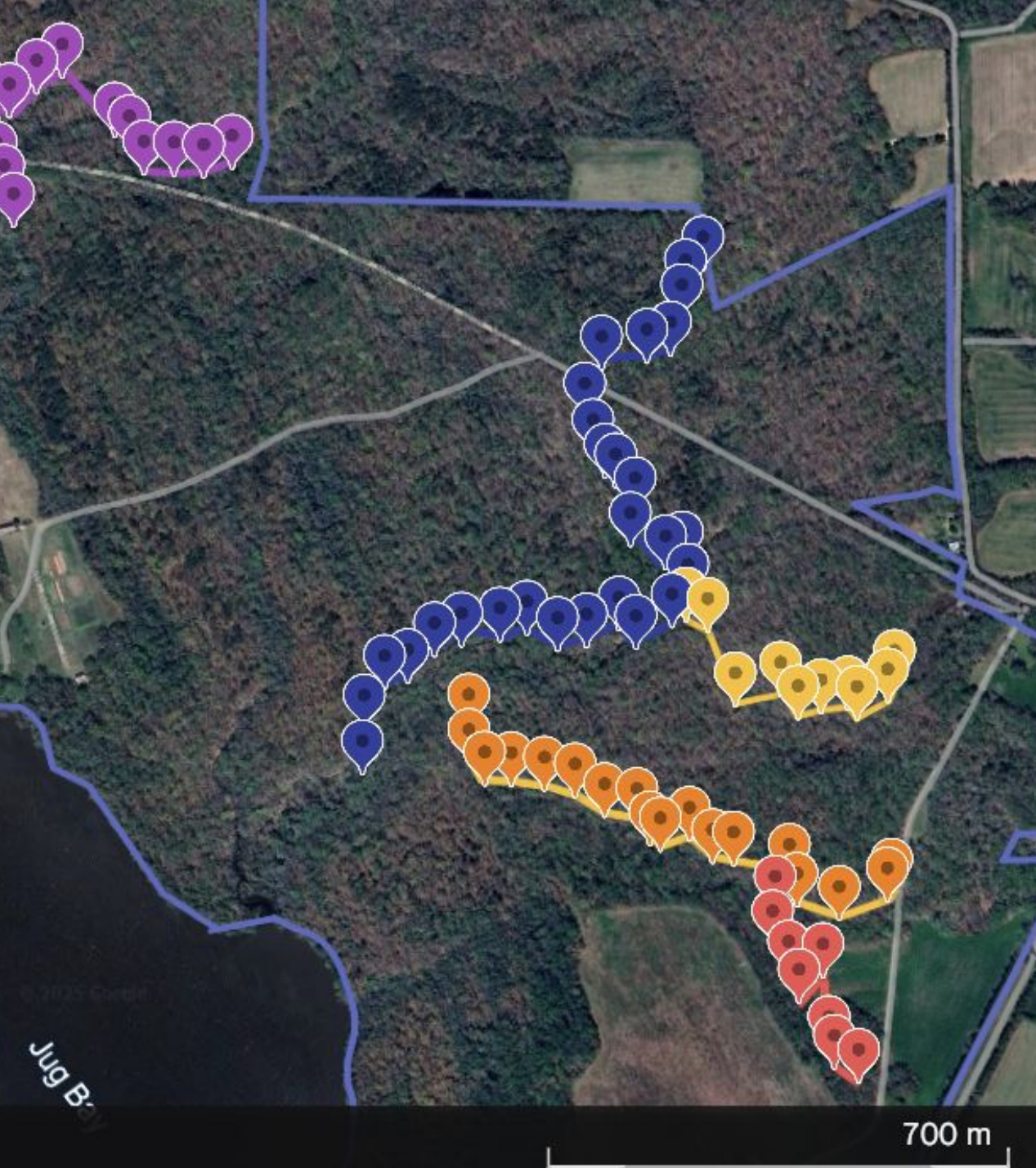
The main questions of my study

- Is there a significant difference between the dissolved oxygen, pH and water temperature between the streams in Jug Bay?
- Does pH, dissolved oxygen and water temperature affect the number of salamanders that can be found in Jug Bay streams?
- Is there a significant difference of salamander populations between the streams in Jug Bay?



Sampling Sites

- I sampled 5 streams at jug bay
- Yellow: Reach 1(10 plots)
- Orange: Reach 2 (18 plots)
- Red: Reach 3 (8 plots)
- Blue: Pindell Branch (28 plots)
- Purple: Two-Run Branch (15 plots)
- In total I had 79 plots
- Most of my plots were in forested areas with minimal sunlight and many trees around
- The closer I got towards the Jug Bay the more some of my plots became more floodplain areas with less trees and more grasses present



Possible Aquatic Salamanders at Jug Bay

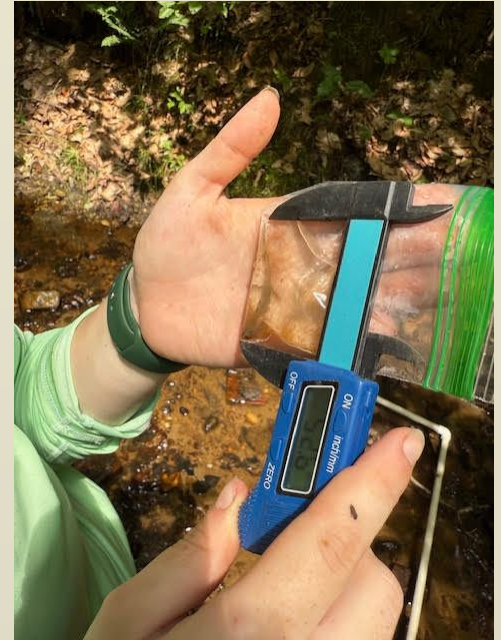
- Northern dusky salamander (*Desmognathus fuscus*)
- Northern two-lined salamander (*Eurycea bislineata*)
- Red salamander (*Pseudotriton ruber*)
- Mud salamander (*Pseudotriton montanus*)



- There are 6 other species in Anne Arundel County, but these species are either terrestrial, or they mainly live in ponds

Sampling Methods

- The first step of my sampling involved marking all the streams in Jug Bay every 50 meters (~ 164 feet)
- 50m sections were chosen because it should provide enough distance between sites to prevent the same individual from being counted multiple times, yet not too great of a distance as to risk missing an individual's entire home range.
- After labeling every stream I went back to each flag and placed a 1m x 1m frame down, roughly in the middle of the stream





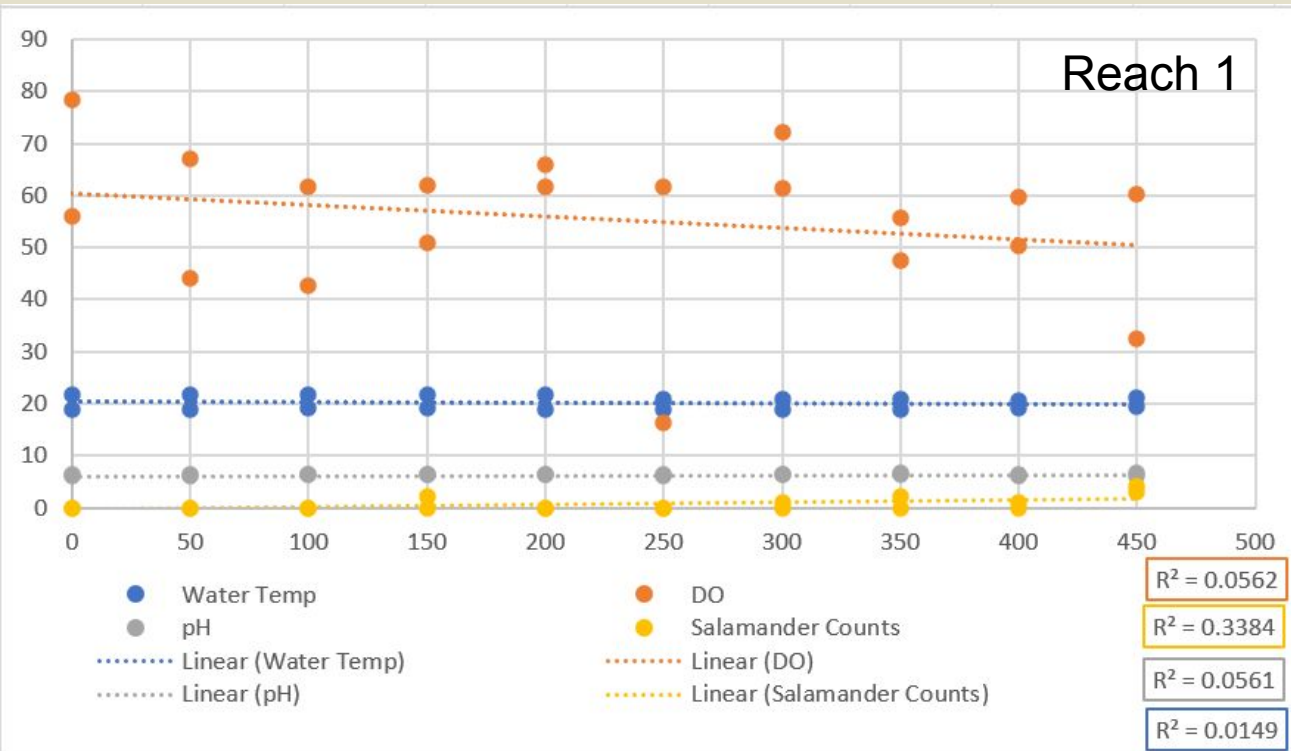
Sampling Methods



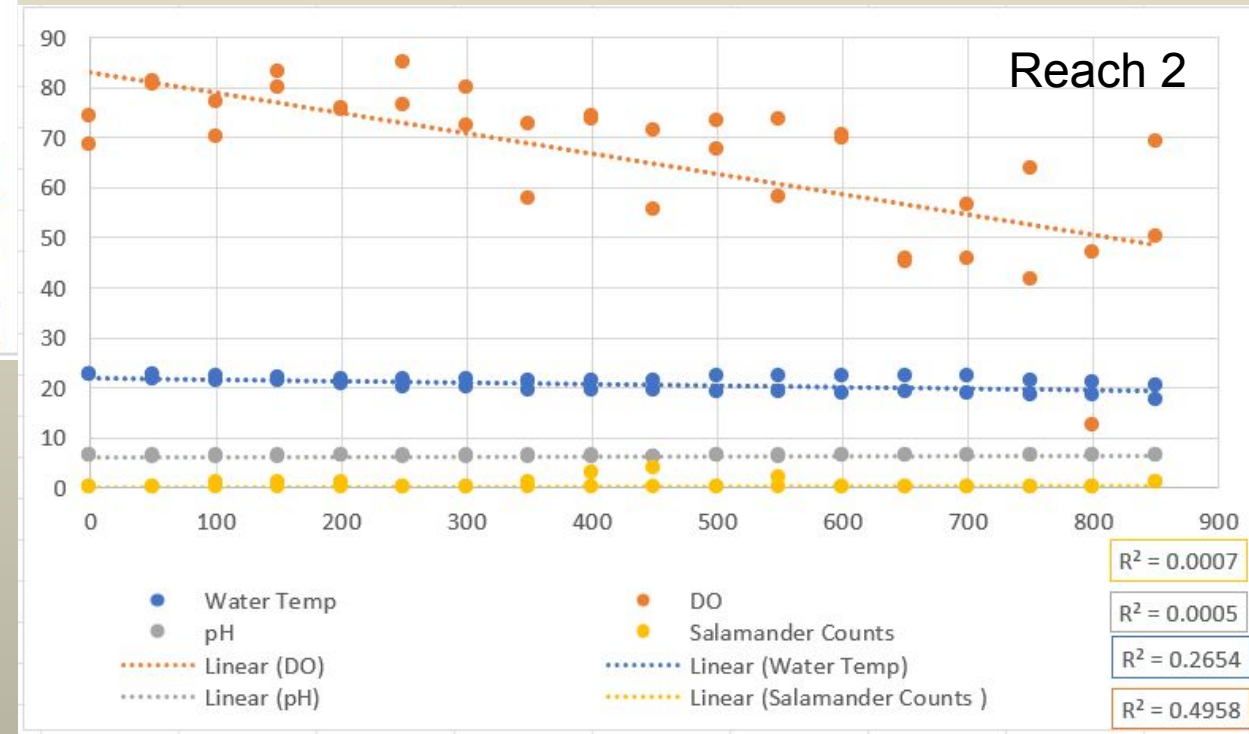
- After placing my frame down, I set a timer for 10 minutes and began searching for salamanders
- This included flipping rocks and logs if they were present and skimming the water with a small net
- If a salamander was found, I placed it in a sandwich bag and measured it
- After my 10 minutes were up, I used the YSI probe to measure water temperature, pH and dissolved oxygen in each plot
- I also recorded time of day, weather, air temperature and sediment type

Eliminating distance as a factor

Since every plot was 50 meters apart it was important to make sure that distance did not influence pH, dissolved oxygen, water temperature or salamander counts



A linear regression was done on all these factors for every stream. All R-squared values were low indicating a minimal relationship between distance and these factors



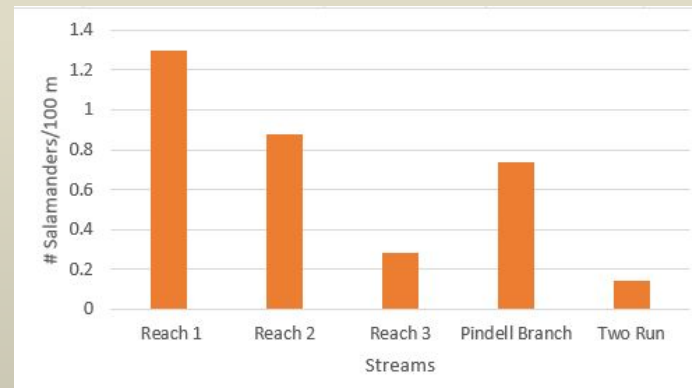
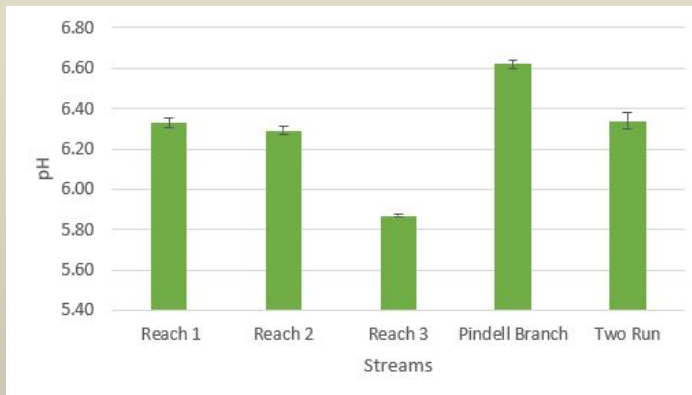
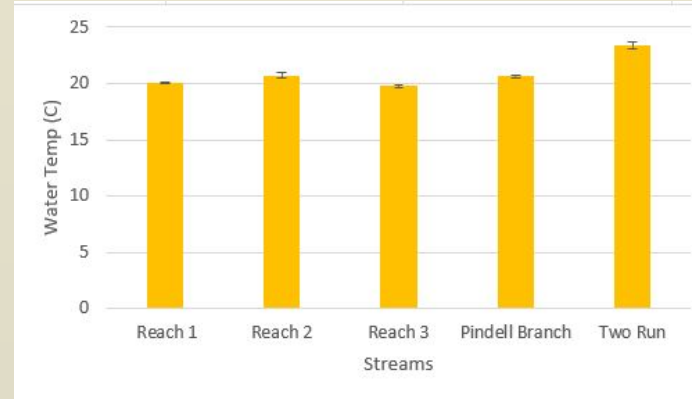
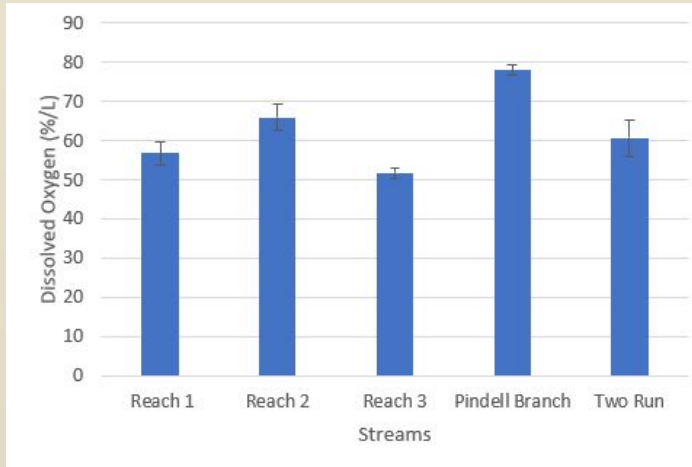
DO vs. # of salamanders	r(b)
Reach 1	0.01
Reach 2	0.28
Reach 3	0
Pindell	-0.11
Two Run	0.53

Air Temp vs. # of salamanders	r(b)
Reach 1	0.27
Reach 2	-0.08
Reach 3	0.06
Pindell	0.06
Two Run	0.41

Water Temp vs. # of salamanders	r(b)
Reach 1	-0.54
Reach 2	-0.21
Reach 3	0.27
Pindell	0.06
Two Run	-0.67

Biserial results

- After eliminating distance as a factor, the next step was to test if pH, dissolved oxygen or water temperature affected the presence/absence of salamanders
- This was done using a biserial correlation coefficient which assess the relationship between a numerical values (pH, temperature, dissolved oxygen) and a variable that can have to values (presence or absence)
- The closer the r(b) value is to 1 or -1 the better the relationship is between the variables
- Since most of the r(b) values are low we can state that water temperature, dissolved oxygen and pH are not an important factor in the presence or absence of salamanders at Jug Bay



Comparing averages

- Dissolved oxygen, pH and water temperature were each averaged across streams to compare
- The number of salamanders found was standardized by breaking it down into salamanders/100 meters of stream. This was done because all streams were different lengths

ANOVA results

	p-value
Number of salamanders	0.1089
Water temperature	9.90E-21
Dissolved oxygen	1.20E-06
pH	1.20E-15

- An analysis of variance (ANOVA) was completed to see if the streams were different from each other in water temperature, dissolved oxygen, pH and number of salamanders
- To be significant the value needed to be under .05
- Water temperature, dissolved oxygen and pH were all statistically different between the streams

pH					
	Reach 1	Reach 2	Reach 3	Pindell Branch	Two Run
Reach 1		0.88	7.8998	6.4681	0.1384
Reach 2			8.0018	9.0361	1.1544
Reach 3				15.291	8.6883
Pindell Branch					7.2704

Dissolved Oxygen					
	Reach 1	Reach 2	Reach 3	Pindell Branch	Two Run
Reach 1		2.4974	1.1645	6.2593	1.0076
Reach 2			3.6179	4.3723	1.6407
Reach 3				7.1297	2.2013
Pindell Branch					5.9209

Water Temperature					
	Reach 1	Reach 2	Reach 3	Pindell Branch	Two Run
Reach 1		3.1668	1.3347	2.8542	15.6103
Reach 2			4.4293	0.6538	14.6562
Reach 3				4.2021	16.0027
Pindell Branch					16.6309

Tukey Test

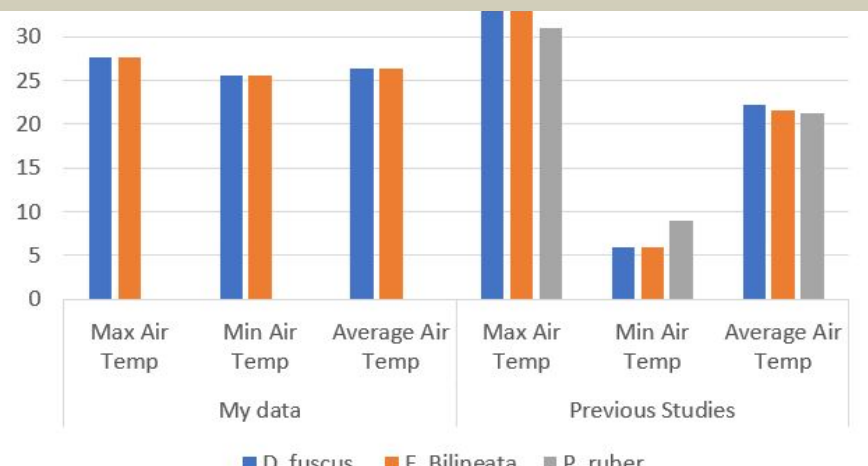
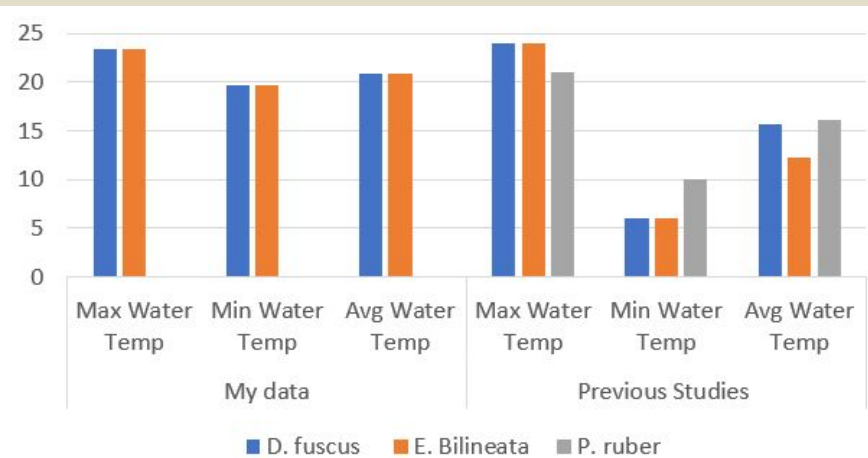
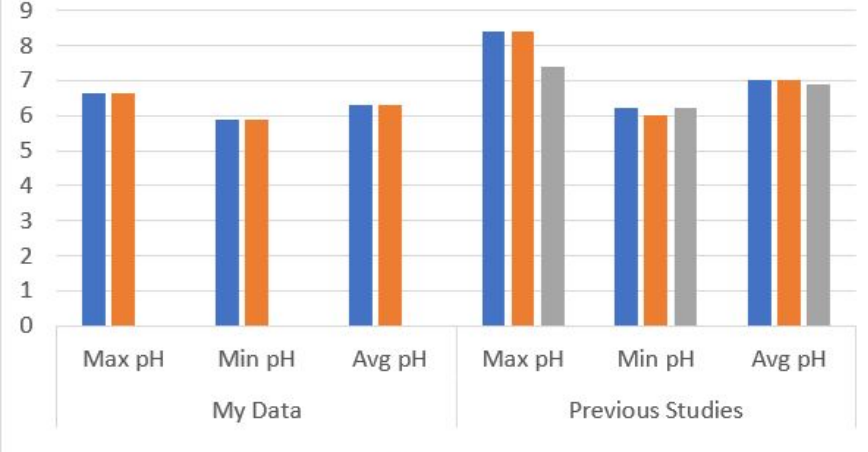
- An ANOVA can tell you there is a difference between 1 or more of the streams, but it can't tell you which streams are different from each other
- This is where a Tukey test comes in, as it can tell you what streams differ from each other
- On the charts each box highlighted green indicated a significant difference
- In pH all of Pindell branch and Reach 3 differed from the 3 other streams
- In dissolved oxygen Pindell branch differed from the other 4 streams

Salamanders found



- I found adult Northern two-lined salamanders, I did not see any adult Northern dusky salamanders
- Most seen were larvae, the larvae were either Northern Dusky salamanders or Northern two-lined salamanders
- They are very difficult to tell apart, on the top right is a Northern Dusky, the bottom left is a northern two lined

Comparison graphs



- These graphs are comparing data that I collected to a study conducted in 2008
- The pH, water temperature and air temperature for Northern two-lined (*E. bislineata*) and Northern dusky (*D.fuscus*) all fall within the given ranges seen in previous studies
- The red salamander (*P. ruber*) fell within some of these ranges but are known to be more sensitive
- Where Northern two-lined and Northern dusky are the most tolerant of a range in environmental conditions

Ecological knowledge

- Adult northern dusky are known to travel farther from the stream or will live in burrows by the stream
- Mud salamanders do not breed until late summer or early fall, and adults are known to live in underground burrows and are notoriously cryptic in nature
- Red salamanders also do not breed until late summer or fall, and adults have a terrestrial period from early spring into early summer



What does this mean

- The most important thing to understand is just because I did not find mud salamanders, red salamanders or adult northern dusky salamanders does not mean they are not there
- My study is only providing a small snapshot as my surveys only took place from June-July
- However, I can say that some of the environmental conditions seen during these months in these 5 streams would not be ideal for mud salamanders or red salamanders





Revisiting the main questions

- There is a difference between pH, dissolved oxygen and water temperature between the streams in Jug Bay
- These environmental factors do not impact the presence or absence of salamanders at Jug Bay
- There is not a significant difference between the number of salamanders found in the streams

Future implications



- The streams at jug bay are not in the best quality, there were salamanders found yet they were the most tolerant salamanders
- Restoration and efforts to reduce pollution and increase natural cover (logs, debris, leaves) would be beneficial to the salamander populations
- The more data that could be collected the better, as my data is a snapshot of a much bigger picture

A huge thank you!

- This study could not have been completed without the help of many people
- Thank you first to Pati who helped me start my project, came out sampling with me and helped analyze my data
- Thank you to Ruth, who came out with me when I was first labeling my plots
- Thank you to Jeanette who came out sampling with me on a weekend
- Thank you to the Friends of Jug Bay who funded my research
- Thank you to my mom who first brought me to Jug Bay so many years ago and always asked me about how my salamanders were
- And lastly, thank you to all the employees of Jug Bay who gladly listened to me talk about salamanders everyday at lunch

