Study of Semitoilus atromaculatus at Cathance River Preserve

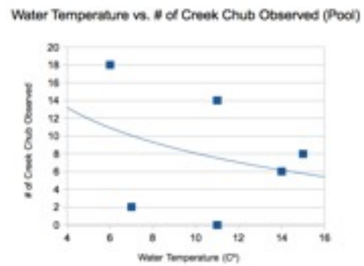
By Dan Pelletier and Lauren Grant

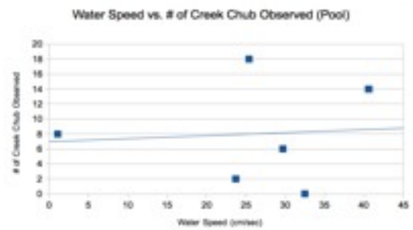
Purpose: To determine whether speed, temperature, and dissolved oxygen levels of a body of water affect the number of Creek Chubs observed.

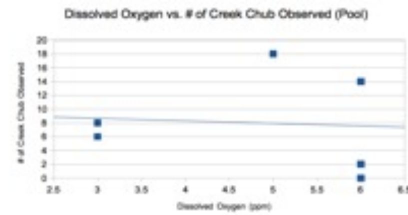
A Little Background Information:

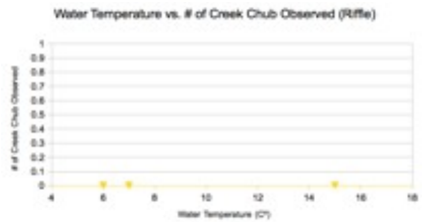
Creek chubs are fresh water minnows. Creek chubs adapt very easily to different habitats and have a very large variety of prey. Creek chubs tend to live in streams or small rivers, and gather around areas of weeds for security. Their upper lethal temperature is 32°C while their lower lethal temperature is 1.7°C. Creek chub enjoy colder waters because they have higher dissolved oxygen levels and they like higher water speeds, too.

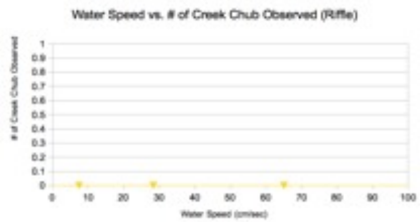
The Cathance River is a freshwater river that rises in Bowdoin from the adjoining West and East Cathance rivers and tracks into Merrymeeting Bay. The fish study is on a small section of the Cathance river near "Barnes Leap" in Topsham, Maine. This section of the river is a good location for studies of populations because it consists of a variety of habitat classifications. There are pools, riffles, and runs (a pool is a deep body of water who's current is slower than the other two, a riffle is a more shallow body of water who's current is faster than that of the pool's, a run is a very shallow body of water that has a very fast paced current and is very choppy), all of which can harbor differences in populations.

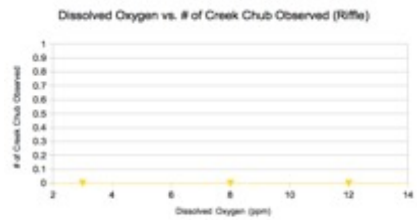


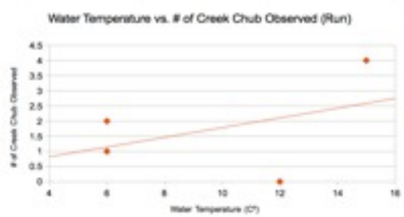


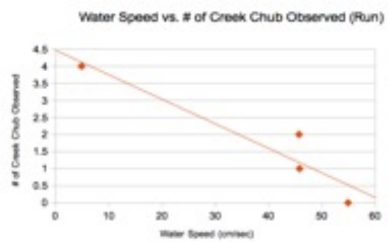


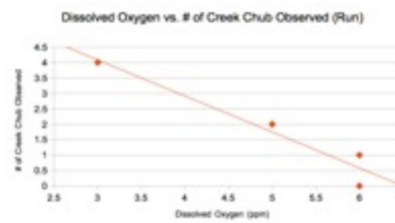












Basic Procedure:

1. On the Cathance River, locate and mark a run, a riffle, and a pool.
2. Place Splash Cam Delta Vision Underwater Camera in stream behind a rock facing current.
3. For all three areas, find temperature, dissolved oxygen levels, and water speed. Meanwhile, second partner observes fish camera footage.
4. After measurements are completed, pack up all materials.
5. Repeat steps 2-4 weekly from September 13 through October 26, 2012

Hypotheses: If the speed of the water is slower, more creek chub of certain species will be present in that section of water.

If the temperature of the water is higher (to a certain point), more creek chub of certain species will be present in that section of water.

If the dissolved oxygen levels in the water is higher, more fish of certain species will be present in that section of water.

Conclusion: Creek Chub prefer water speeds between twenty centimeters per second to forty centimeters per second. They also prefer temperatures between 6° and 8° Celsius. In addition, they prefer levels of dissolved oxygen between 4.5 and 6 ppm.

A map of CRP, study area circled.

The Place Splash Cam Delta Vision Underwater Camera CREA lent us!

Setting up the fish camera.

Walking to the river with our materials.

Thanks to:
Cheryl Sleeper
CREA
Mr. Evans
SAD75
Mike Chelminski
Stantec

Dan Pelletier
Novemeber 20, 2012
R1 and R2
Lauren Grant

<u>Creek Chub (*Semotilus atromaculatas)* Population Observations in a Pool, Riffle, and Run According to Dissolved Oxygen Levels, Water Speeds, and Water Temperatures.</u>

Problem: Does water speed, water temperature, or dissolved oxygen levels of a body of water affect the presence of Creek Chub's present in the pools, riffles, and runs?

Background information:

Ichthyology, the study of fish, has, at least informally, been around for several thousands of years (paintings of fish dating back to 1500 BC have been found, and that can be considered ichthyology). Charles Lesuer, a French explorer who described and illustrated Atlantic Coast fish, was a famous ichthyologist in the late 1700's and early 1800's. Another famous ichthyologist is David Starr Jordan, who is considered by many to be the "father of American ichthyology" because he began and established the Hopkins Marine Station at Stanford.

The study of fish has evolved over time. For example, when it started people would just draw sketches of how they remember the fish being. Today, though, scientists will catch the fish with high-tech nets, they will use boats to go out in the ocean and catch deep-sea fish, they will use tools to tell water factors like temperature, dissolved oxygen, depths, speed, clarity, and some even go into the water (using scuba gear) to catch fish.

For this experiment, all of the tests are done at the Cathance River Preserve, with support from the Cathance River Education Alliance. The Cathance River Education Alliance is a "non-profit organization dedicated to using the resources of the Cathance River Preserve to educate students, educators, and the public". The Cathance River Preserve is 235 acres in area and was formed in 2000. The goal of The Cathance River Preserve is to provide a place where teachers are able to bring their students and do special projects, to preserve and foster wise use of the Cathance River Preserve, and to develop programs that educate the public about ecology, environmental preservation, and sustainable living.

The Cathance River Preserve has several streams that flow into the Cathance River and many trails that run along the side of those streams. The land at The Cathance River Preserve is largely undeveloped, and is representative of most of the stream ecosystems in the midcoast Maine area.

A fish of the Cathance River is called a "creek chub"(*Semotilus atromaculatus*). Semotilus means banner (referring to the dorsil fin), ater means black, and maculatus means spotted (referring to the fin spots). Chubs are curious fish. They will investigate whatever falls in the water. This sometimes causes them to be caught by predator fish. Another odd behavior of chubs is that they will allow other fish to lay eggs in their nest, lessening the chance that their eggs will be taken by a predator.

Creek chubs are freshwater minnows. Creek chubs adapt very easily to different habitats and have a large variety of prey. Creek chubs tend to live in streams or small rivers, and gather around areas of weeds for security. Their upper lethal temperature is 32ºC while their lower lethal temperature is 1.7ºC. Creek chub like colder waters because they hold more oxygen, and they like higher water speeds, too.

Creek chub do, in fact, fight with other fish for habitat and protection, but often still travel in groups to ensure safety. The creek chub's diet consists of other fish, insect remains, vegetation, amphipods, adult Coleoptera (beetles), Ephemeropta (may fly) nymphs, Odonata (dragon fly) larvae, and Diptera adults and larvae. Adult fish typically feed around noon, and generally no earlier than 11:00. Creek chub fish have many predators. Some of their predators are loons, kingfishers, brown trout, and northern pike.

The Cathance river is freshwater and rises in Bowdoin from the adjoining West Cathance and East Cathance rivers and track into Merrymeeting Bay. The fish study is on a small section of the Cathance River near "Barnes Leap", in Topsham, Maine. This section of the river is a good location for studies of populations because it consists of a variety of habitat classifications. There are pools, riffles, and runs, all of which can harbor differences in populations which will be explained.

The Cathance River also contains different types of areas that provide "microhabitats" to various organisms.

There are rocky areas with larger rocks where depth is very inconsistent, and there are also more shallow areas with smaller rocks where water depth is more consistent. These rocks provide microhabitats for organisms. Some organisms that cling to rocks cling to the side facing directly against the current, while other organisms typically can rest behind the rock to stay out of the current, while still able to hunt for food and move about. Organisms that hide from predators can do so under rocks, and organisms that need to come up for breath can do so on top of rocks.

There is also an area of the Cathance River where it is a few inches to a foot deep, and the bottom is covered in a long, green moss. This moss can be home to smaller water insects escaping the current, bacteria, and some fungi.

The primary research site is a stretch of river of about 300 feet. This is a relatively small area, which is convenient for research. The area includes the three types of water habitats; a run, a pool, and a riffle.

A riffle is the most shallow section of a stream or river. It is where the water slows as it travels over the rocks and is more uneven and rough. Sunlight shines all the way to the bottom, encouraging growth of diatoms (a single-celled algae). Riffles are generally not productive areas for fish because any eggs laid will be washed away. Riffles are, however, home to plants and algae because of the abundance of sunlight shining through.

A run is a deeper, more smooth-flowing stretch of water than the riffle. Water speed is more rapid and the water is calmer, due to the increased depth. The bottom of the run in the research area is covered with long, fibrous mosses, which could quite possibly be a type of

Cladophora. This moss covers the entire surface of the bottom of the run. This makes this run in particular inhabitable to bacteria, fungus, and insects.

A pool is the slower moving, deeper section of a stream or river where the flow of water slows down. Because of this decrease in water speed, the water deposits its load of silt and other organic materials to the bottom of the pool. In this layer of silt, the environment is generally more inhabitable for plants and animals that can't tolerate higher water velocities. These animals typically don't inhabit the riffles or runs due to the current. A variety of worms, beetles, frogs, small and large fish, and insects frequently live in pools. The pool in our research area is a typical pool where frogs have been seen, as well as fish and insects in the water.

The definition of a riffle, run, and pool varies from river to river and stream to stream. For example, if the river is more shallow, a run may be classified as a section of river that is an average of 1 foot deep. While in a larger, deeper stream a run may be classified as a section of river that is an average of 6 or 7 feet deep. Each classification is relative to the size and characteristics of the individual stream.

Purpose: To assess and compare the number of Creek Chub within a pool, riffle, and run relative to dissolved oxygen level, water speed, and water temperature.

Hypotheses: If the speed of the water is slower, more creek chubs will inhabit that section of water.

If the temperature of the water is higher (to a certain point), more creek chubs will inhabit that section of water.

If the dissolved oxygen levels in the water is higher, more creek chubs will inhabit in that section of water.

Procedure:

1) Gather the materials to measure the population of fish in the stream as well as the abiotic and biotic factors, gather a laptop, a Splash Cam Delta Vision Underwater Camera, a thermometer that measures in celsius, a net, a Ward's Dissolved Oxygen Test Kit, waders, a pencil and a notepad, and about ten metal-wire flags to mark certain points.

2) Find three different areas: one a "riffle" (shallow water, less than one foot deep with high flow speeds.), another a "run" (water deeper than one foot with perceptible flow speed), and another a "pool" (water deeper than one foot with no perceptible flow speed). NOTE: All of these areas must be connected by a flowing stream of water. Mark these points with different colored wired flags. Draw a sketch of the area and mark these three areas on the sketch.

3) For each of the three areas, find the temperature with the thermometer (keep the thermometer in the water for three minutes before checking the temperature), the speed of the water (by marking off a fifteen-foot long straight in the section (don't let the section type change in the fifteen foot span), putting a short stick at the front of the area, and timing the time it takes for it to reach the end of the fifteen feet), and the dissolved oxygen levels in the water by following the directions in the kit given to you.

4) While somebody is completing step three, the other partner must be monitoring the fish camera which will be strategically placed in the water to find fish. The researchers must place the camera in a place where they would predict the fish to be, such as the calmer waters behind a large rock in the current.

5) After all of the data has been found and recorded, the thermometer, the fish camera (which should be coiled up neatly and have its lens cleaned), and the dissolved oxygen level finder will be gathered together and packed up.

6) Researchers will make weekly measurements starting on the thirteenth of september and ending on the twenty-sixth of october.

Safety Considerations:

Put your waders on once you reach the water, only then. Climbing down the rocks with the shoes the waders provide is dangerous. Also, make sure to check the waders before bringing them to the water, because they could have a leak. Also, walk very slowly through the water and "feel" with your feet for rocks to avoid tripping on them.

Observations:

On the days where it rained a lot before or during the time of the stream, there was no use for putting the camera in because the water was too murky to see any quick-moving fish swim by the stream. That's why there are lots of dates with "n/a" as the data, because there was not any information.

The creek chub lingered behind rocks in the current, perhaps because they wanted a break from swimming.

In the videos, the creek chubs like to come in groups or at least pairs. They were almost never alone.

Data Table:

Number of Creek Chub vs. Water Speeds, Dissolved Oxygen Levels, and Water Temperatures ("n/a" means no information was recorded on that day)

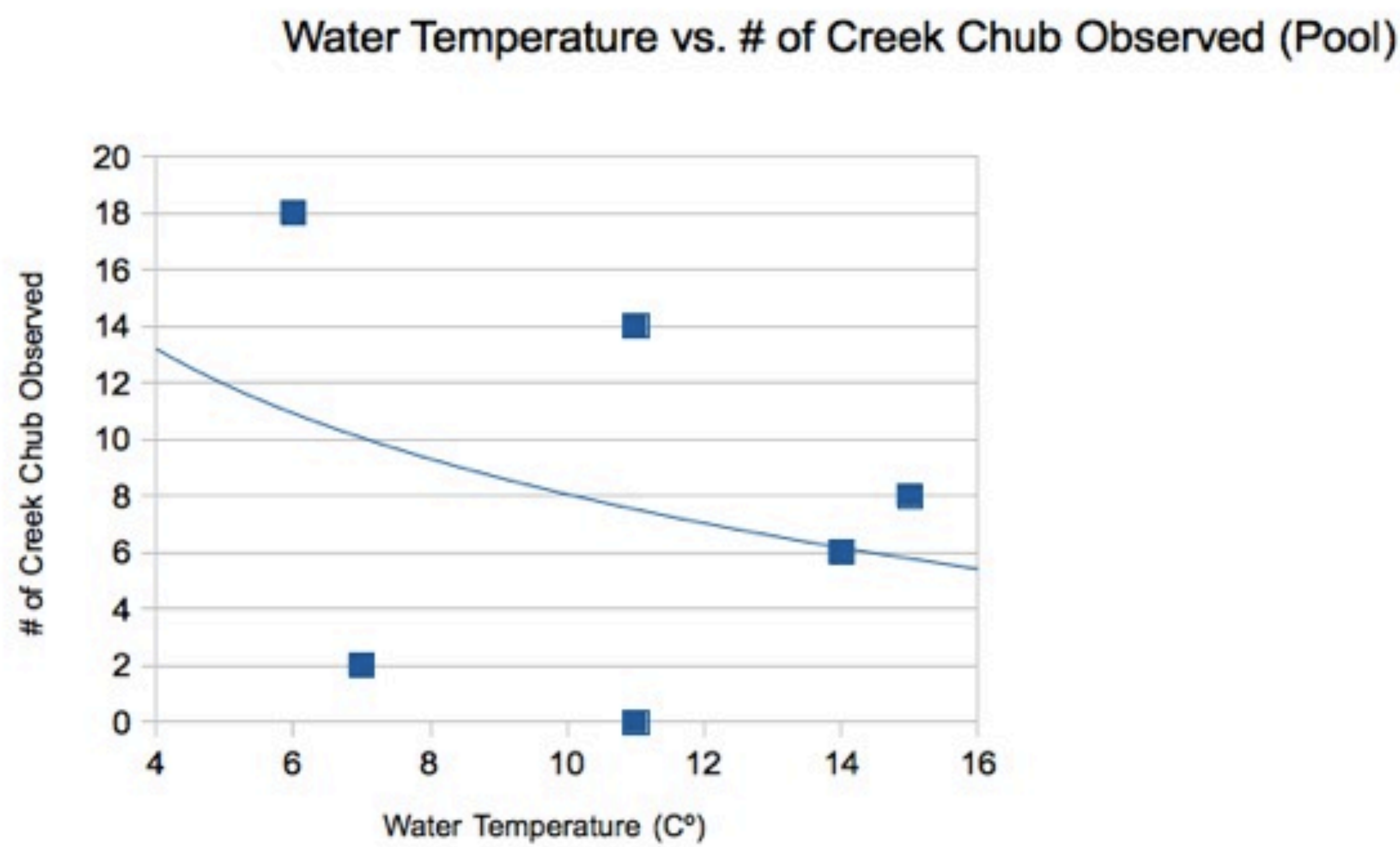
Date	Location	D.O. (ppm)	Temp. (ºC)	Water Speed (cm/sec)	# of creek chub
9/6/12	Pool	3	14	445	6
	Run	3	14	557.8	n/a

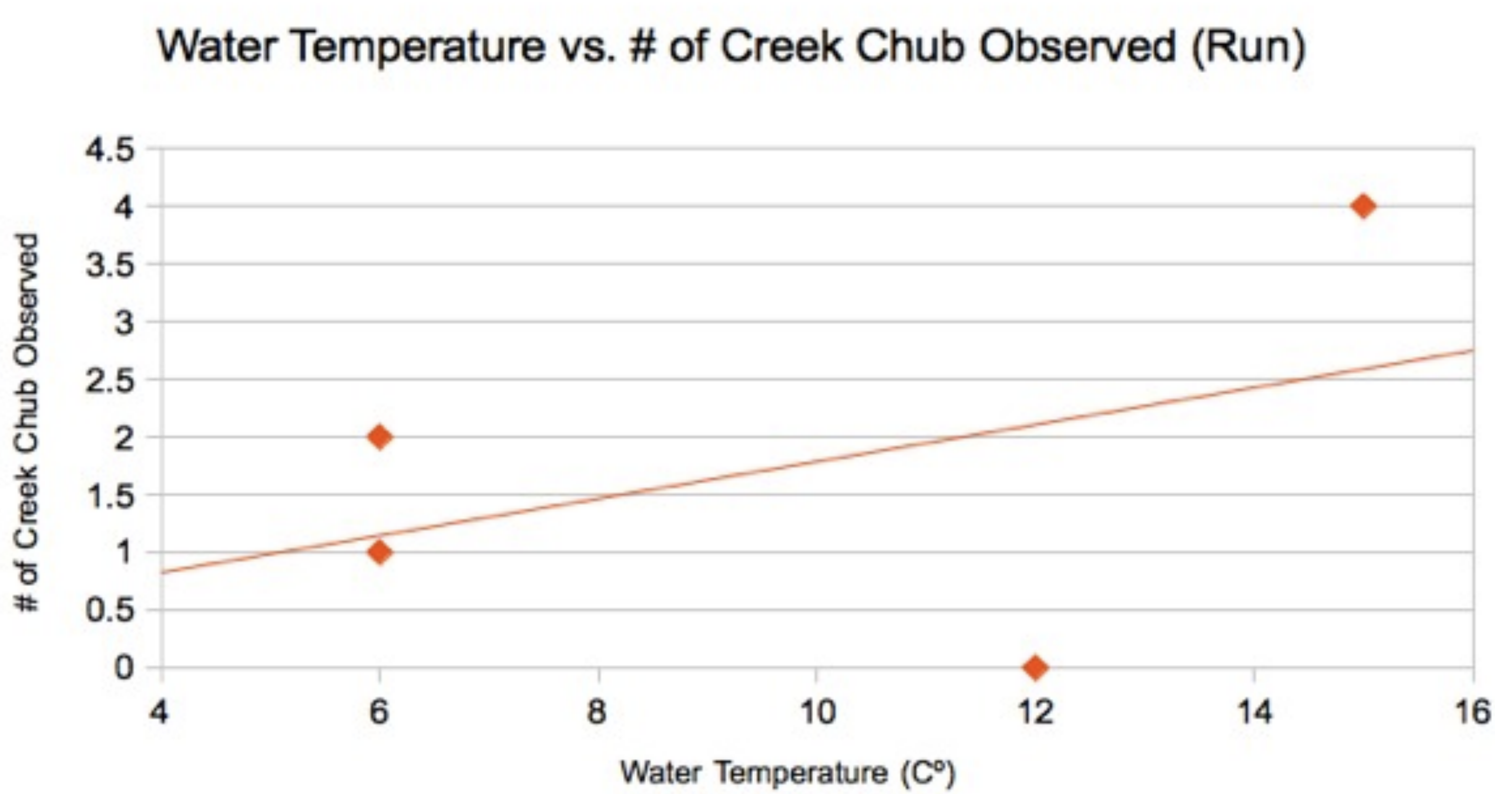
Date	Location	D.O. (ppm)	Temp. (°C)	Water Speed (cm/sec)	# of creek chub
	Riffle	3	16	853.44	n/a
9/14/12	Pool	3	15	16.3	8
	Run	3	15	74.1	4
	Riffle	3	15	112	0
9/20/12	Pool	6	11	609	14
	Run	6	12	365.6	n/a
	Riffle	6	11	731.5	n/a
10/4/12	Pool	5	9	548.6	n/a
	Run	5	10	742	n/a
	Riffle	5	9	1402.8	n/a
10/12/12	Pool	5	6	381	18
	Run	5	6	685.5	2
	Riffle	12	6	426	0
10/18/12	Pool	6	7	355	2
	Run	6	6	687.2	1
	Riffle	8	7	976	0
10/26/12	Pool	6	11	487.7	0
	Run	6	12	822.9	0
	Riffle	6	11	1066	n/a

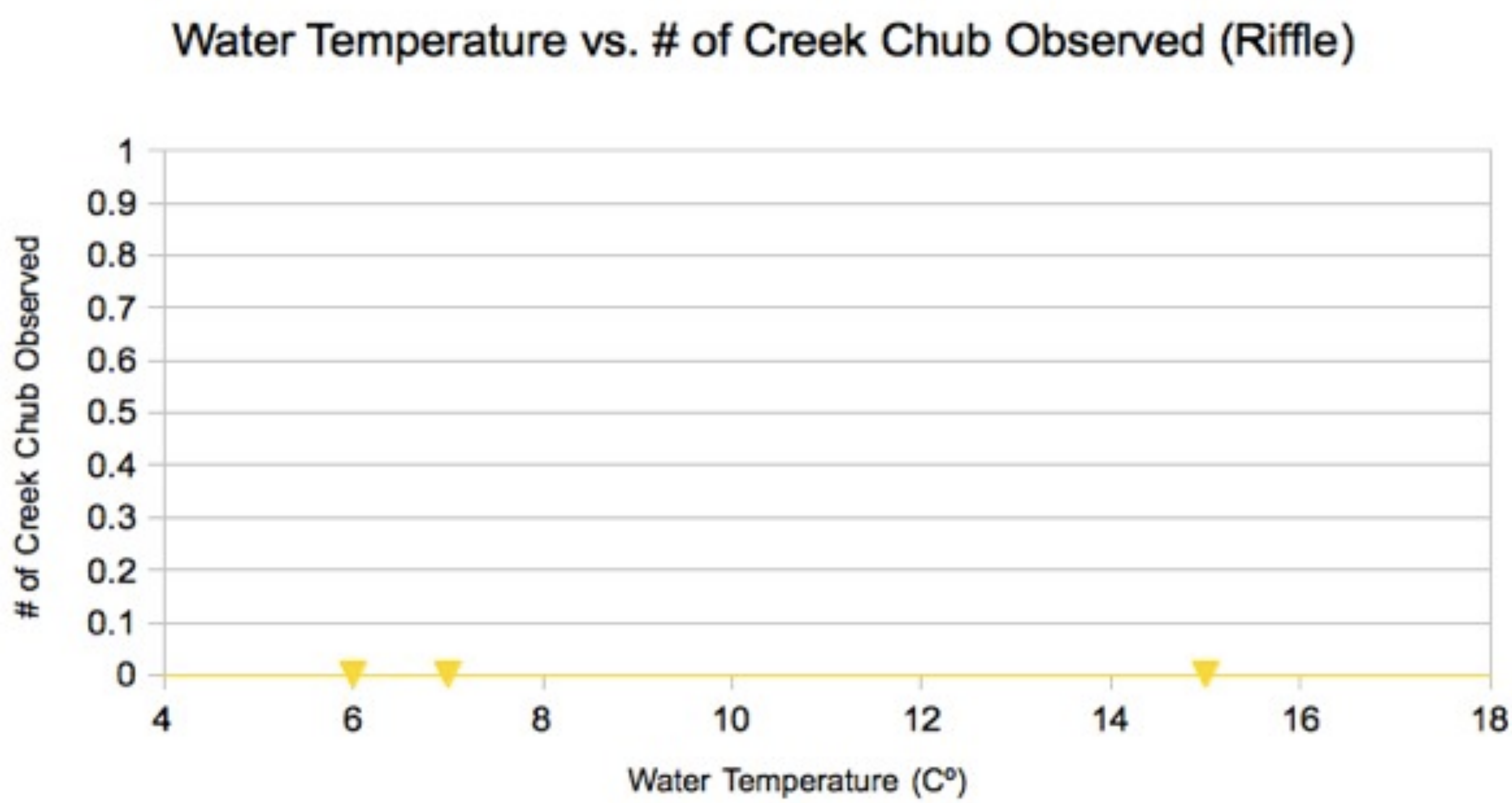
Calculations:

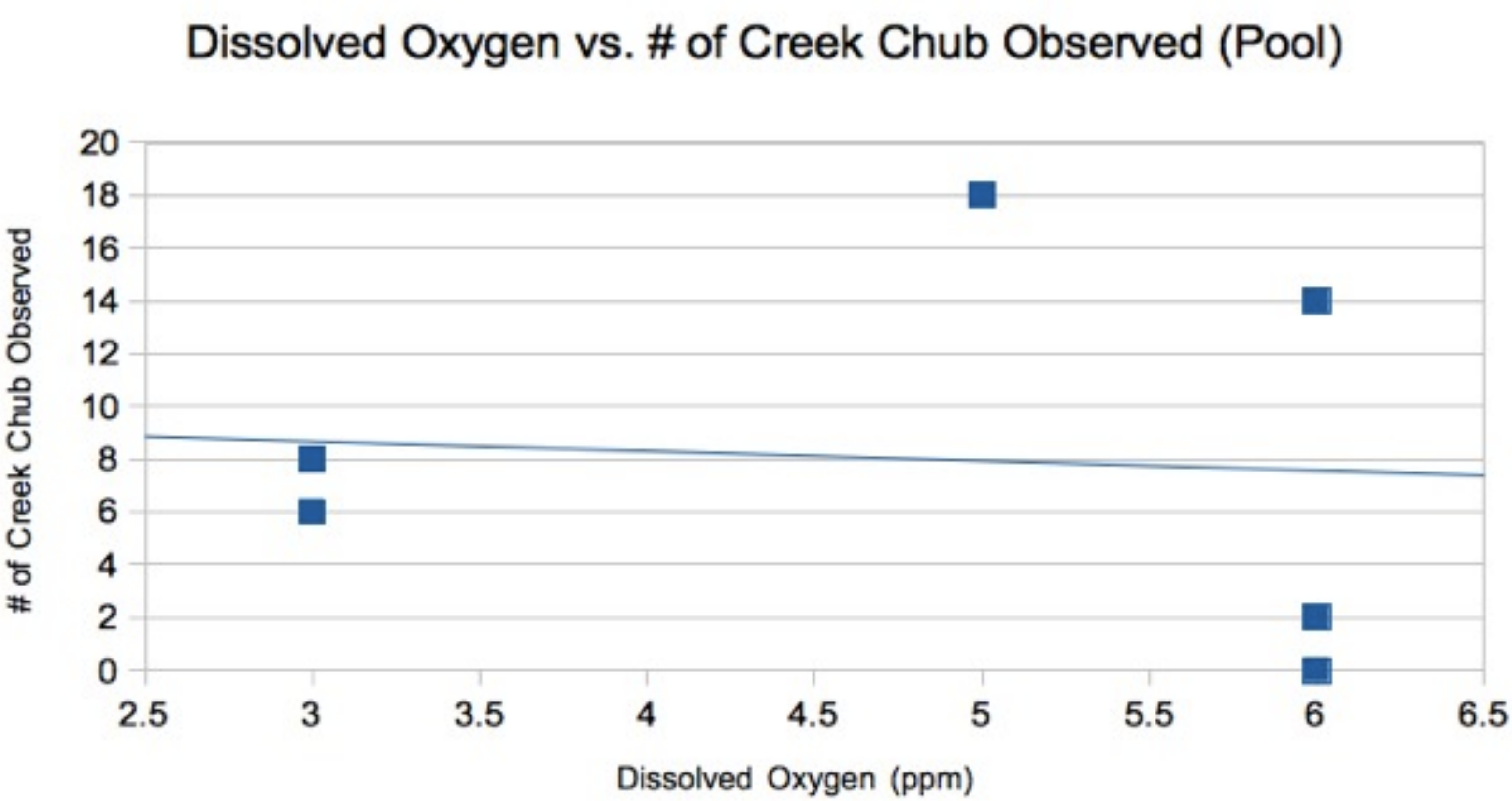
The researchers calculated the water speed by dropping a small piece of wood (4-6 inches long) into the current and measuring the distance in feet within fifteen seconds. This was done three times, and the researchers then calculated the average of the three numbers, and converted from feet to centimeters. The researchers would then convert the number of feet to centimeters by using the Google Converter.

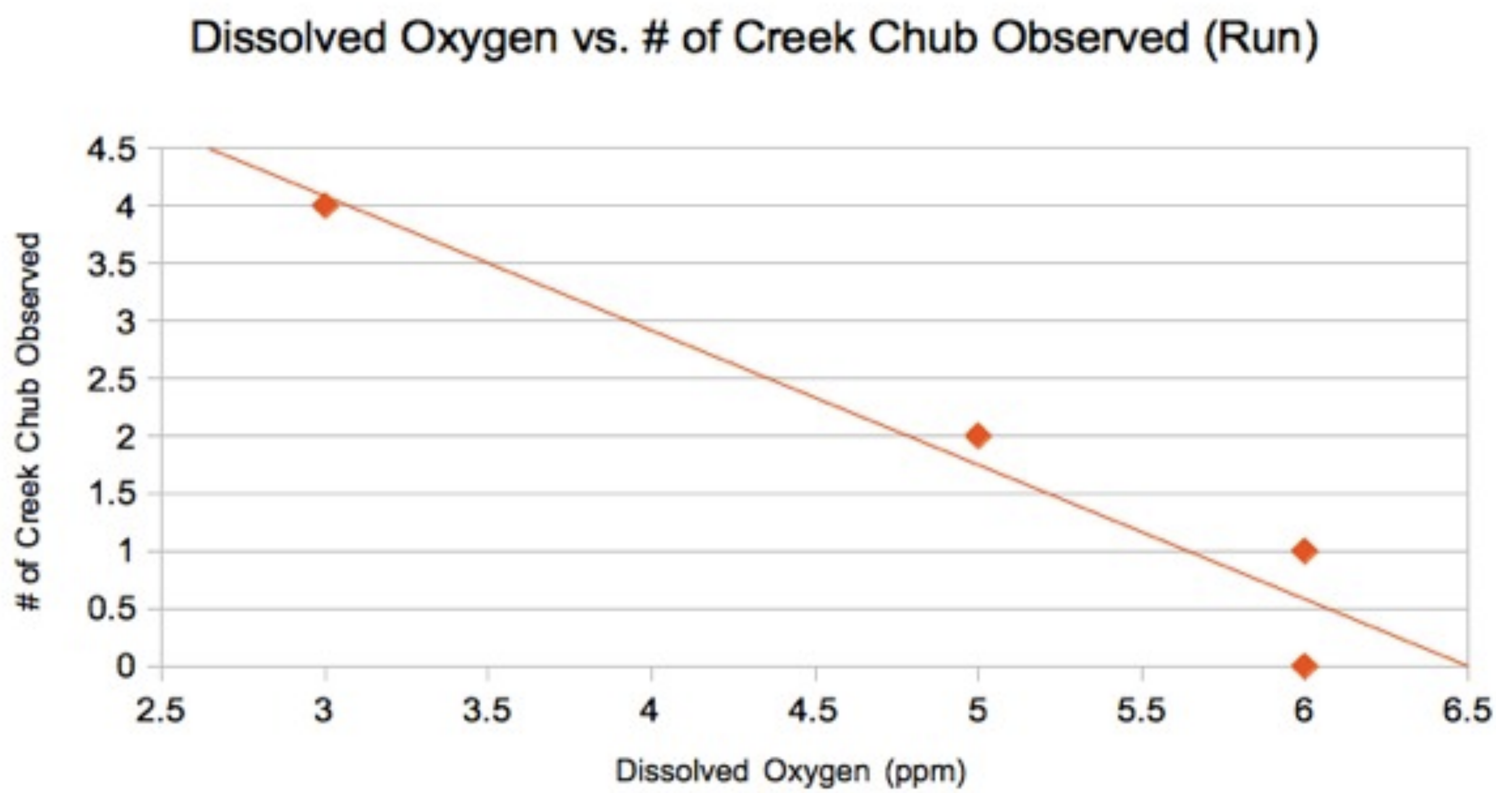
Graphs:

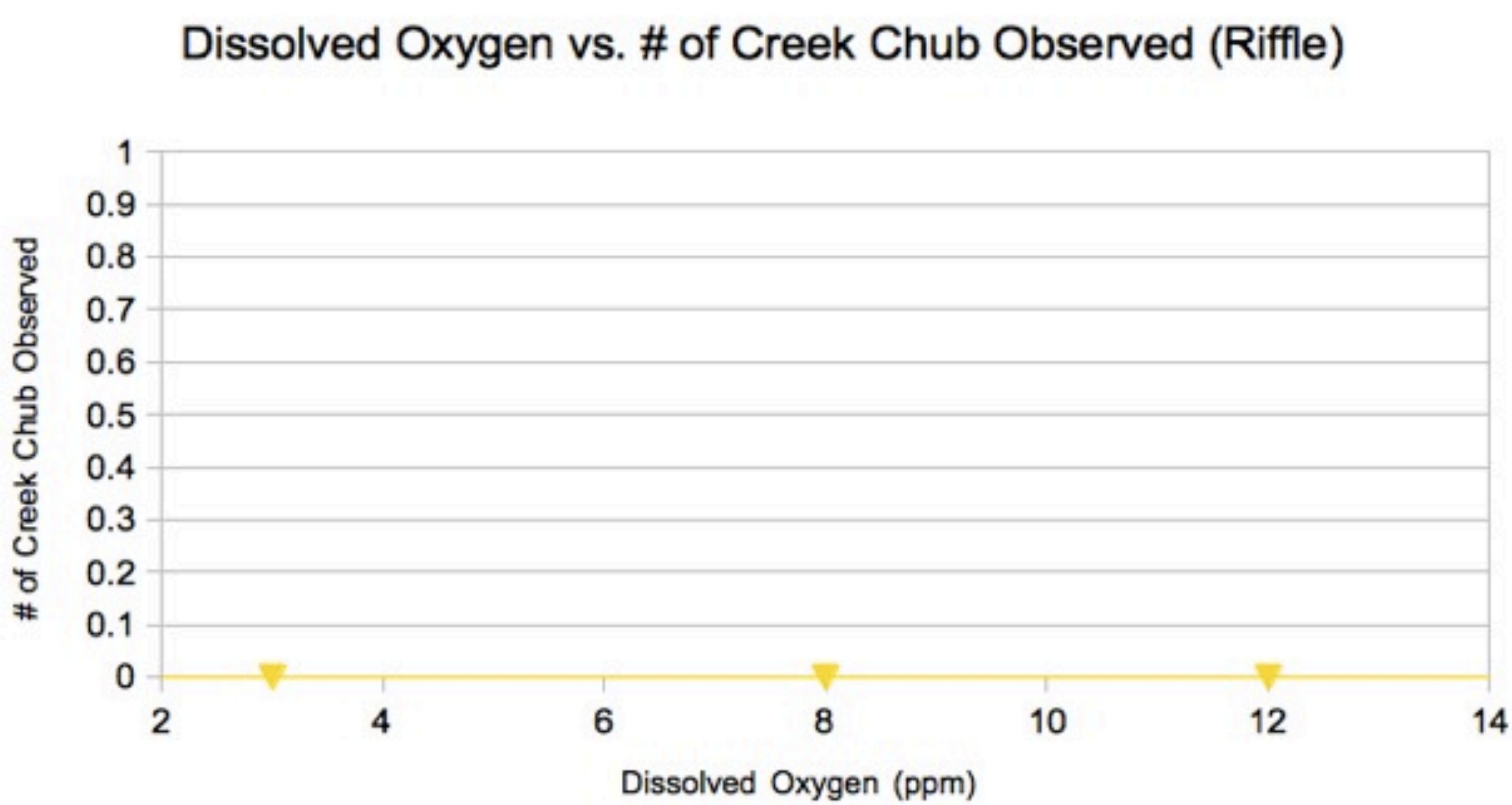

Water Temperature vs. # of Creek Chub Observed (Pool)
# of Creek Chub Observed
20
18
16
14
12
10
8
6
4
2
0
4
6
8
10
12
14
16
Water Temperature (C°)


Water Temperature vs. # of Creek Chub Observed (Run)
# of Creek Chub Observed
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4
6
8
10
12
14
16
Water Temperature (C°)


Water Temperature vs. # of Creek Chub Observed (Riffle)
# of Creek Chub Observed
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4
6
8
10
12
14
16
18
Water Temperature (Cº)


Dissolved Oxygen vs. # of Creek Chub Observed (Pool)
# of Creek Chub Observed
20
18
16
14
12
10
8
6
4
2
0
2.5
3
3.5
4
4.5
5
5.5
6
6.5
Dissolved Oxygen (ppm)


Dissolved Oxygen vs. # of Creek Chub Observed (Run)
# of Creek Chub Observed
Dissolved Oxygen (ppm)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2.5
3
3.5
4
4.5
5
5.5
6
6.5


Dissolved Oxygen vs. # of Creek Chub Observed (Riffle)
# of Creek Chub Observed
Dissolved Oxygen (ppm)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
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2
4
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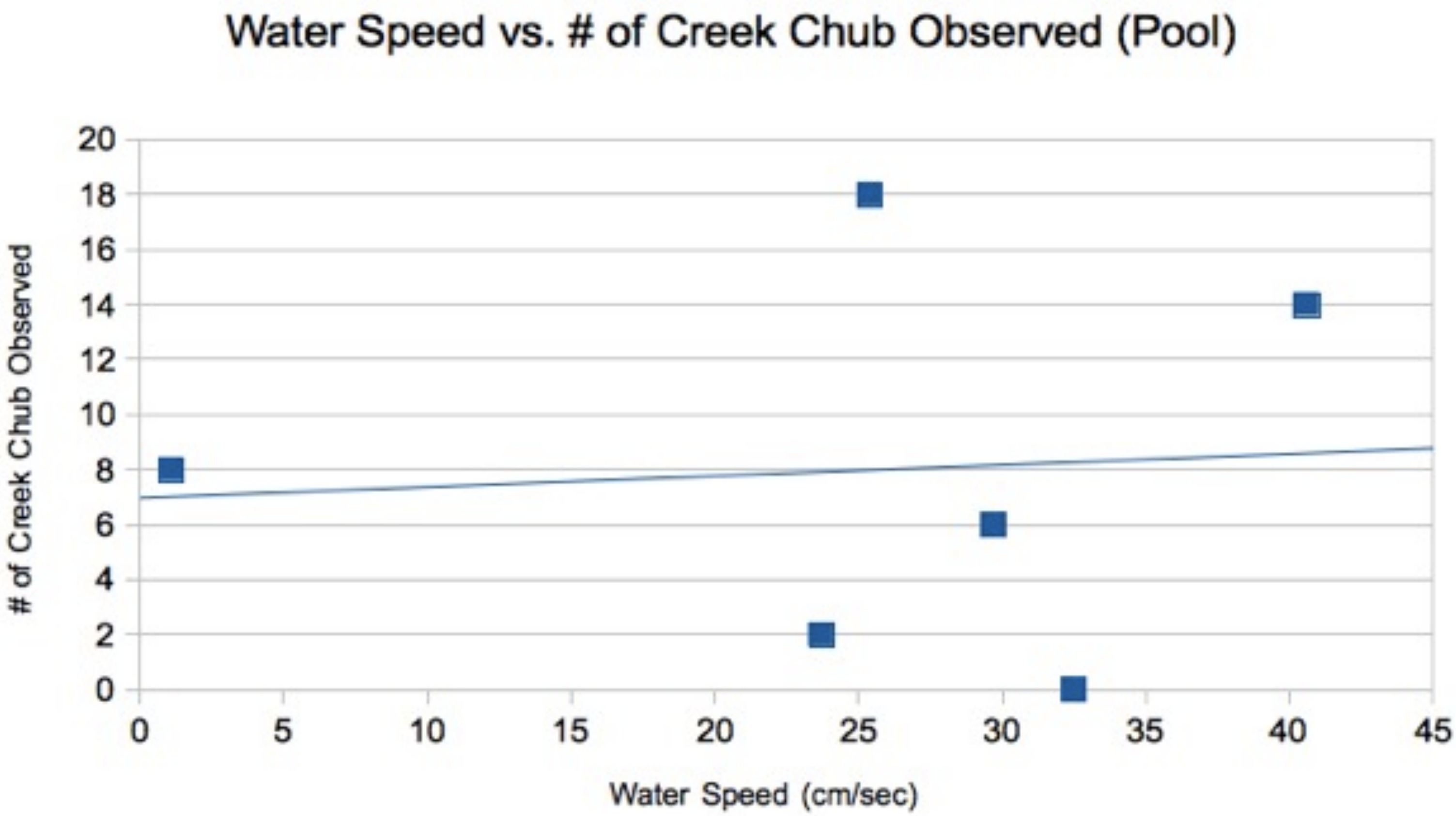
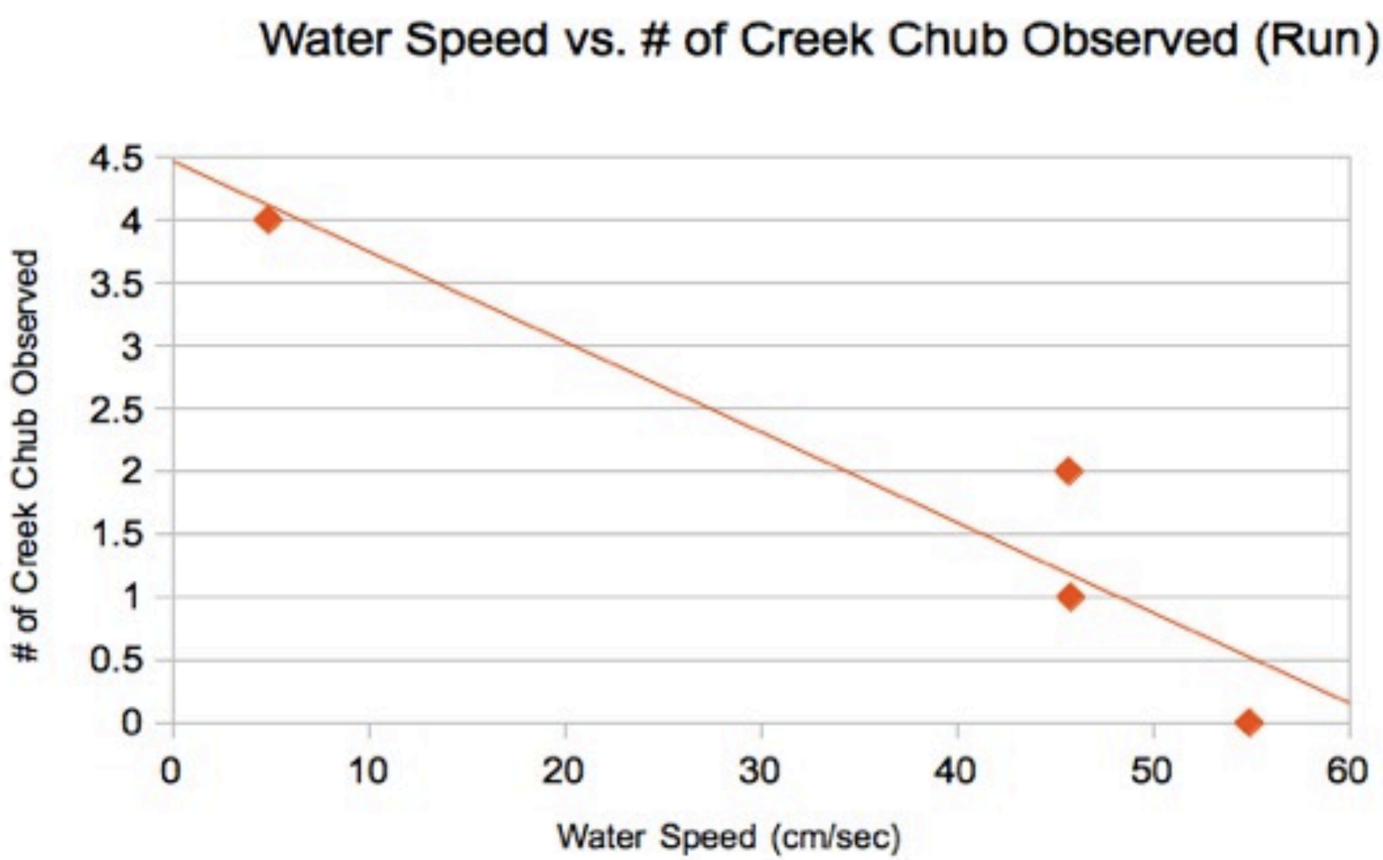
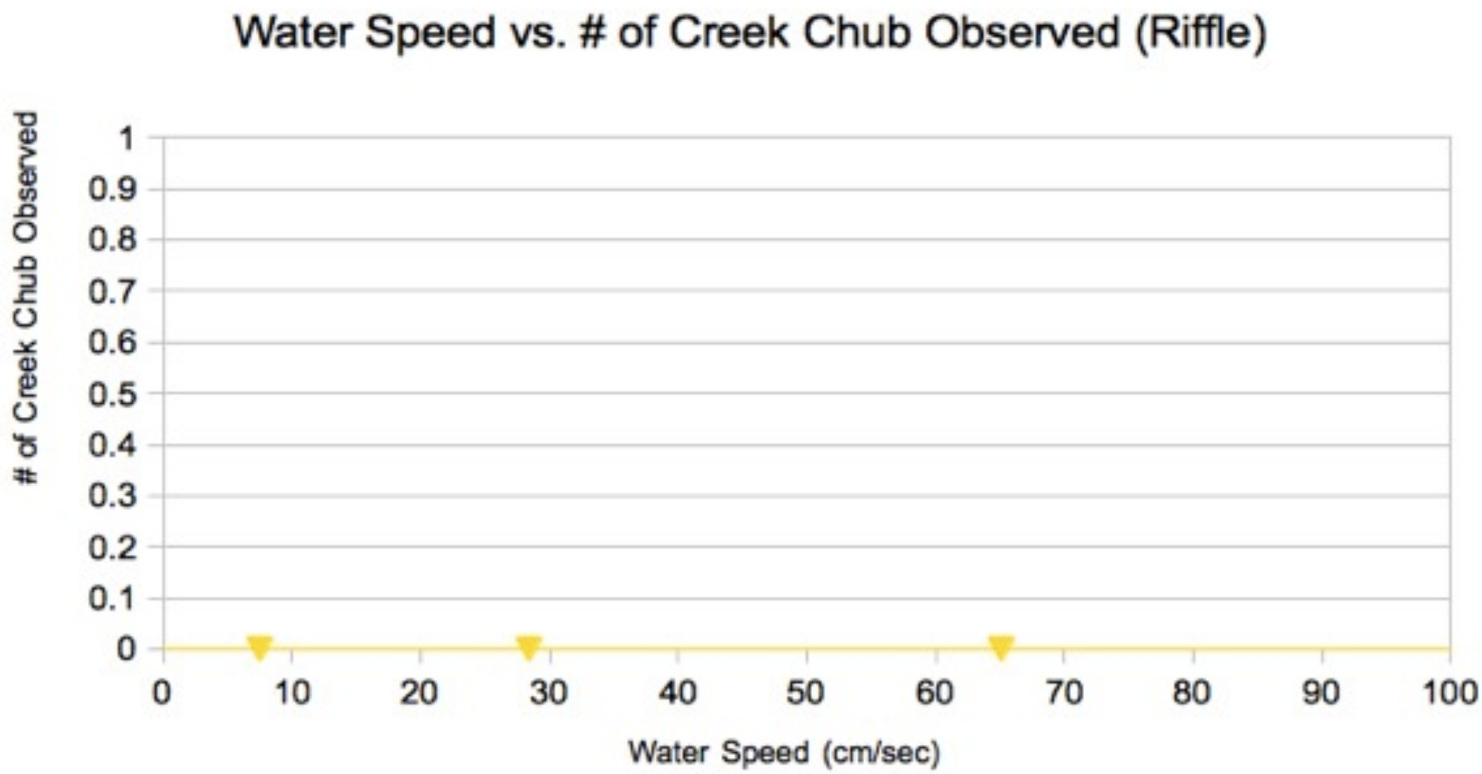
8
10
12
14


Water Speed vs. # of Creek Chub Observed (Pool)
# of Creek Chub Observed
Water Speed (cm/sec)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
30
35
40
45


Water Speed vs. # of Creek Chub Observed (Run)
# of Creek Chub Observed
Water Speed (cm/sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
10
20
30
40
50
60



Analysis:

The researchers saw the most fish in the pool, while only a small amount in the riffle, and none in the run. The researchers never saw any fish in the run because the waters were too shallow and too quick for us to be able to see any fish through the camera. The overall Creek Chub observed ranged from zero to eighteen in the pool, zero to four in the run, and in the riffle, remained at zero all through the study. Each day, the pool and riffle had equal dissolved oxygen levels (varied from day to day and ranged from three parts per million to six parts per million), while the dissolved oxygen levels in the run were equal to both the pool and the riffle except for on 10/12/12 and 10/18/12, when they were higher at 12 ppm and 8 ppm. The temperature remained between 6ºC and 16ºC, and decreased from 16ºC as the months passed by. The water speed varied greatly because it was most affected by the amount of precipitation over the stream, and there were some days when the it rained very hard.

Conclusion:

Creek chubs prefer colder water. This is demonstrated by the higher number of creek chub observed in colder waters (in 5ºC water there were 18 creek chubs). Creek chub likely prefer colder waters due to the higher levels of dissolved oxygen in the water. Creek chubs also prefer brisk water speeds, and that is demonstrated by the higher number of Creek chub observed in waters with speeds between 20 centimeters per second and 40 centimeters per second. Creek chubs likely prefer faster water speeds because these waters bring nutrients and objects down the water, so feeding and receiving nutrients is much easier. The hypothesis on the water speed was wrong, because it predicted Creek chub will be more present in slower waters when they were actually more present in generally faster waters. The hypothesis on water temperature was incorrect too, because it predicted Creek chub will be more present in higher temperatures when they are actually more present in colder waters. Finally, the hypothesis on dissolved oxygen levels was correct because it predicted more Creek chub would be present in waters with higher dissolved oxygen levels, which proved to be true.

Some error in the process of conducting the experiments could have slightly skewed the data. The first and most likely influence is that the small area viewed by the fish cam is not representative of the entire site where data is being taken such as behind big rocks that block the current, where the creek chub could rest and search for food. The entire site can't be viewed at once, so the fish cam was set up in places where creek chub are expected to appear most often. On any given day, the amount of chub seen in footage from the fish cam may not reflect the number of chub present at the site. Some other human errors that could have skewed data are measurement of water speed and oxidation levels. Measurement of speed relies on the ability to accurately track an object floating down the stream for fifteen feet. Measurement of oxidation levels relies on the comparison of two shades of blue, one of the sample of water, another from the samples in the kit. Both of these are susceptible to human error.

Due to their lab being new to this program, researchers had no guidelines to follow and there were many improvements that were needed. For example, a camera that monitors the whole mouth of the stream (instead of the camera they have now, which can only monitor a fraction of the stream's mouth) would be preferred. Another improvement would be to have a device that would temporarily shock the fish in the stream, so the researchers could easily count them. Another needed improvement is a more accurate and reliable way to measure the water speed, because in this lab the researchers just used sticks they found on the ground and did not have an exact area where they would measure the water speed. The improvement would be to have a specific area that would be used to measure the water speed every time, and also the researchers would use tennis balls as the floaters. A final improvement to this lab is to have more time to conduct our experiments, because they would often not have enough time to set the camera in all three areas. Enough time on this lab should be about three hours.

Citations

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