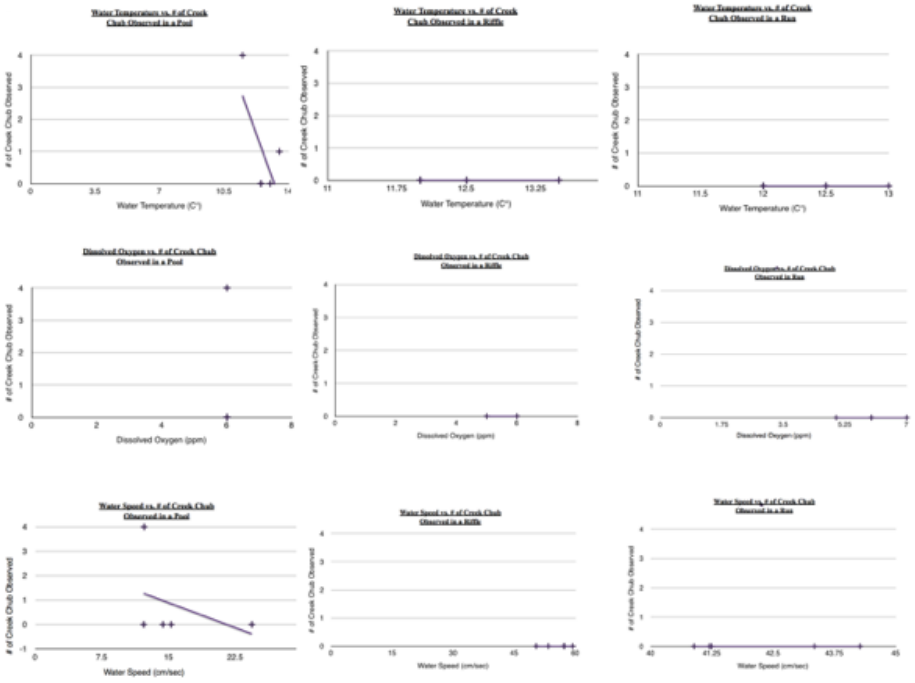
Creek Chub *(Semitoilus atromaculatus)* Study at the Cathance River Preserve

By Erin Tome and Carmen Caterina

Problem: Do speed, temperature and dissolved oxygen levels of a body of water affect the number of Creek Chubs in a run, riffle and pool?

Hypotheses: •If the water is moving faster, there will be fewer Creek Chub in the body of water.
•If the water temperature is higher, there will be more Creek Chub in the body of water.
•If the dissolved oxygen level is higher, there will be more Creek Chub in the body of water.

Procedure: 1. Collect GoPro Camera, Ward's Dissolved Oxygen Kit, metal-backed thermometer (must measure in celsius), meter stick, waders, timer, and a pencil and notepad to record observations.
2. Find a riffle, run and pool along the Cathance River, all fairly close to one another for convenience. A riffle is a short, shallow, with a coarse bottom where the water flows the quickest. A run also has fast moving water, but it is at least a foot deep. A pool is a quiet, slow-moving portion of the stream.
3. Test abiotic factors.
4. Wade in designated area for seven minutes with GoPro camera extended underwater and filming.*
5. Record data and carefully transport materials back to the Ecology Center. Clean tools. Insert cord into GoPro and attach to laptop through the USB port. Save photos/videos, review and record fish observed.
***Seine net replaced camera for final two days at Cathance.**




A creek chub caught in the pool


Checking the seine net for fish in the pool


Pulling the seine net across the pool with mentors


Trekking back to the ecology center with materials

Background: *Semotilus atromaculatus*, commonly known as the creek chub, is a type of minnow that live in small to medium sized streams, and can occasionally be found in lakes. Creek chub's bodies are comprised of an olive-colored back, and silver sides with a long brown stripe. They have round fins. Creek chubs can grow up to twelve inches long, but they are typically smaller. They typically do not leave their shelters and are not active until the temperatures are at the daily maximum. Typically creek chubs feed for 1-2 hours by waiting for drift items. The Cathance River is a 26.4 kilometer body of water that leads to Merrymeeting Bay. The river starts in Bowdoin and flows south into Topsham. It turns northeast into Bowdoinham and then south again into the bay. The abiotic factors that may affect the population of creek chubs are the water temperature, the pH of the water, the dissolved oxygen in the water, and the speed of the water. The water temperature affects the fish because they are only able to survive in water temperatures between 1.7°C and 32°C. The pH range for survival and growth of creek chubs is between 6.0 and 9.0. Oxygen levels below 1-2ppm can be lethal to creek chubs. Chubs prefer speeds between 20 and 40 centimeters per second.

Conclusion: It would be inaccurate to draw firm conclusions with the amount of creek chubs the researchers recorded because there were not enough fish consecutively observed to do so. However, limited data from the pool suggests that fish can be found in water where the temperatures are between 12.5°C and 13.5°C, the dissolved oxygen level is 6, and the water speed is 12.23 and 24.33 centimeters per second.

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Erin Tome
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Observations of Creek Chub Populations in a Pool, Riffle, and Run and their Relationship to Dissolved Oxygen Levels, Water Temperatures, and Water Speeds

Problem: Do speed, temperature and dissolved oxygen levels of a body of water affect the number of Creek Chubs in a run, riffle and pool?

Background:

Semotilus atromaculatus, commonly known as the creek chub, is a type of minnow that live in small to medium sized streams, and can occasionally be found in lakes. Creek chub's bodies are comprised of an olive-colored back, and silver sides with a long brown stripe. They have round fins. Eight rays can be found on the back fin of the fish. Creek chubs can grow up to twelve inches long, but they are typically smaller. The fish prefer clear to slightly cloudy water with a gravel bottom. They also like to live near beaver dams. Creek chubs eat Copepods and water fleas when they're young. As adults, they eat aquatic insects, terrestrial insects, worms, and small fish. Creek chubs are preyed by large fish such as largemouth bass, smallmouth bass, walleyes, brown trout, northern pike, kingfishes, mergansers, and even larger creek chubs. They can live up to eight years old, although few make it past five. Female creek chubs reproduce by laying 25 to 50 eggs in a pit then leaving them to hatch later. They spawn in the north in July when water temperatures are 13-18° C. Male creek chubs are usually around 125 mm while females are 105 mm. They can be identified by the small "mustache" that appears on their upper lip. Creek chubs are covered in bony-ridge scales to aid their movement. Cycloid scales make for smooth transport in the water and leptoid scales help protect the fish from predators. Creek chubs typically feed in the afternoon. They typically do not leave their shelters and are not active until the temperatures are at the daily maximum. Typically creek chubs feed for 1-2 hours to wait for drift items. During breeding season, males grow keratin-based bumps on their head to ward off intruding males. They are called "tubercles".

The Cathance River in Maine is 26.4 kilometers and it leads to the Merrymeeting Bay. The river starts in Bowdoin and flows south in to Topsham. It turns northeast into Bowdoinham and then south again into the bay.

The abiotic factors that may affect the population of creek chubs are the water temperature, the pH of the water, the dissolved oxygen in the water, and the speed of the water. They are important because each one has a different effect on the fish. The water temperature affects the fish because they can only survive in the water temperatures between1.7°C and 32°C. Anything outside of that temperature range will cause the population to decrease. The pH of water can affect the population of creek chubs because water that is too acidic or basic would cause the fish to die. The pH range for most survival and growth in creek chubs is between 6.0 and 9.0. Dissolved oxygen can affect the population of creek chubs because they prefer levels between 4.5 and 6ppm. Oxygen levels below 1-2ppm can be lethal to creek chubs. Lastly, the

speed of the river can affect the creek chub population because there will be more fish where the water is flowing faster. They prefer speeds between 20 and 40 centimeters per second.

The three places the researchers are going to be looking at are a riffle, run and pool. A riffle is a rocky or shallow part of a stream or river with rough water. Riffles are usually found in the middle part of a river, and are wider than the rest of the river, depending on the location. Riffles also oxygenate the water. In hot weather, chubs may congregate in riffles, where the oxygen content of the water is highest. Eggs that the females lay in riffle often do not survive because they get washed away by the current.

Runs are similar to riffles, because they both travel at fast speeds. They are different because the surface is smooth enough to allow light to penetrate. Runs are usually deeper than riffles, but it depends on the size of the stream. Since the current is calmer that a riffle, creek chubs may move to a run to save energy when feeding.

A pool is one of the most obvious features of a stream. Pools provide the two factors that are generally lacking in cold water streams: depth and still water. Since current in pools, especially near the bottom, is almost nonexistent, it is difficult for food to travel. “The tongue of the pool” is where a riffle or a run enter the pool, and where all things enter the pool. This area is useful to creek chubs to “sit” and wait for food. The narrow part of the pool where the pool starts to exit into a riffle or a run is called the “tail.” The tail contains a lot of food and therefore contains a lot of fish.

In order to observe fish, the fish must be caught. There is a wide variety of effective ways to catch and observe creek chubs in a lake, but three tactics will be particularly useful in the experiment. These three methods are electroshocking, baiting, and netting. Electroshocking, which is done by a professional aiding the group, is a tactic that stuns fish before they are caught. There is no permanent harm done to the fish, though, so it is considered to be safe. Two electrodes are deliver a current in the water. A fish eventually is impacted by the path of the voltage, which causes galvanotaxis, muscular convulsions that guide a fish towards the source of the voltage (the electroshocking equipment). In addition to one person operating the device, another person is needed to catch the fish in a net.

Netting is another method used in the experiment. It can be used with the electroshock method, but can also be used on it’s own. A large net is stretched across the width of the riffle, run or pool and is left in place for a given amount of time. It is important to make sure there are minimal escape routes so researchers are able to catch nearly all of the fish swimming through the given location. After the given amount of time, researchers carefully guide one of the towards to opposite end; this traps the fish. The net is then slowly pulled up and researchers clear the net of vegetation and muck. The fish laying in the net are counted and observed.

The third method is baiting. The most convenient foods in a creek chub’s diet are cat food, sardines, and earthworms. If baiting is used alongside netting, it is important to put out the food a day or two before the net is pulled. Otherwise, the bait can be put on a hook.

Another tactic simply requires sitting and waiting. One researcher should stand with waders on in the given area and record video underwater for a constant amount of time. The videos should then be reviewed and any fish viewed should be counted.

In order to observe fish caught with any of these methods, a camera should be used. A GoPro is a high-definition camera and can be enclosed in a water proof case. The case is

attached to the end of a long rod that can be extended underwater, making for prime video. The camera can also be held high above the subject, making for sufficient camera/video observations of fish caught.

Purpose: To assess the effects of water temperature, dissolved oxygen levels and water speed on the population of creek chubs in a riffle, run and pool.

Hypotheses:
If the water is moving faster, there will be fewer Creek Chub in the body of water.

If the water temperature is higher, there will be more Creek Chub in the body of water.

If the dissolved oxygen level is higher, there will be more Creek Chub in the body of water.

Materials:
Ward's Dissolved Oxygen Kit, GoPro Camera, metal-backed thermometer, net, waders, laptop, meter stick, timer, seine nets

Procedure:
1. Collect GoPro Camera, Ward's Dissolved Oxygen Kit, metal-backed thermometer (must measure in celsius), meter stick, waders, timer, and a pencil and notepad to record observations.
2. Find a riffle, run and pool along the Cathance River, all fairly close to one another for convenience. All three areas should be connected by the same flow of water. After the first day, each area should be marked with a small flag indicating the approximate location of the research site. GPS coordinates are as follows: Run: 43°57'29.85" N, 69°56'55.10" W; Riffle: 43°57'30.59" N, 69°56'57.42" W; Pool: 43°57'31.92" N, 69°56'51.23" W. See attached map for approximate locations.
3. Test dissolved oxygen levels (use Ward's Dissolved Oxygen Test Kit), temperature (keep thermometer in for three minutes) and find water speed (hover meter stick over water and time a small piece of wood as it travels from start to end).
Wade in designated area for seven minutes with GoPro camera extended underwater and filming.
When using a technique besides the GoPro, the researchers may use a seine net. Hold one end of the net on one side of the river, then have someone else wade in the water to the other side. Make sure the lead bottom is on the floor of the river and slowly pull in the net to observe number of fish caught.
6. Record data and carefully transport materials back to the Ecology Center. Clean tools. Insert cord into GoPro and attach to laptop through the USB port. Save photos/videos, review and record fish observed.

Safety Considerations: Researchers should be careful when getting into the water, because the wet rocks tend to be slippery and are easy to trip over. The researcher in the water should always

be supervised by a fellow student or mentor because of the chance of slipping and falling. Prior to entering the river, the waders should be checked for holes. Leaking waders create cold feet and uncomfortable situations. Dress for cold weather and expect the water to be significantly colder than the air.

Observations:

The original procedure included observing creek chub solely with the "sit and wait" method (where one researcher extends the GoPro camera downward into the water and waits for creek chub to swim by). This method proved to be unsuccessful as only one creek chub was observed over the course of four weeks.

The use of seine nets proved to be more successful than sitting and waiting as four creek chubs were observed in the pool on one day. It was not as successful in the riffle or run, though, and no fish were caught the following week in any of the three parts of the river.

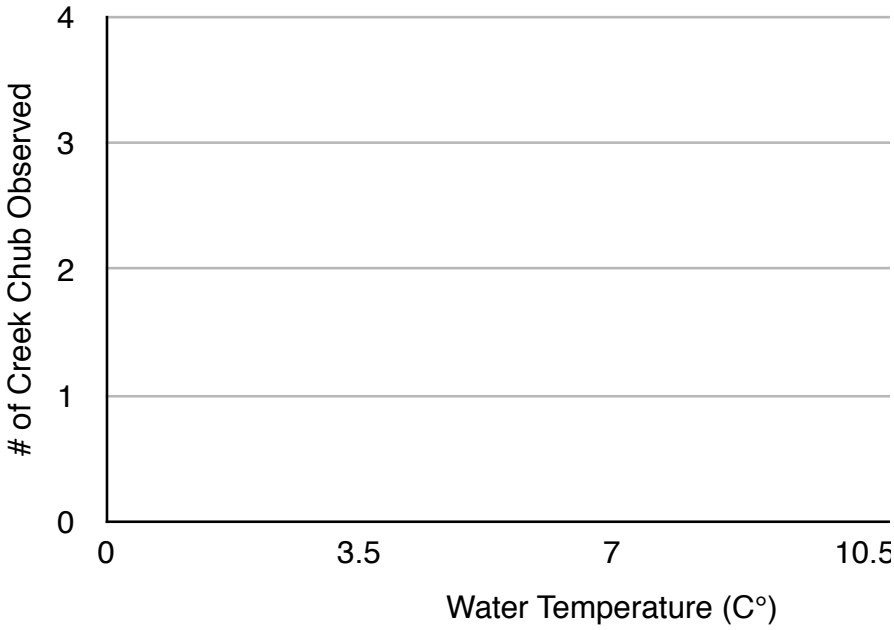
Table:

Number of Creek Chub in Relation to Dissolved Oxygen Levels, Water Speeds, and Temperatures in a Run, Riffle and Pool

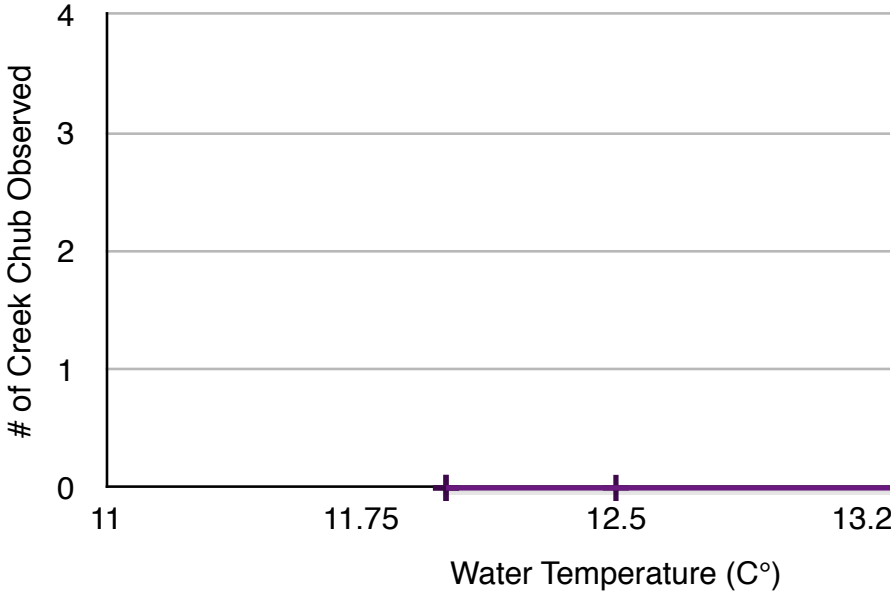
Date	Location	D.O (ppm)	Temp. (C°)	Water Speed (cm/sec)	# of Creek Chubs Observed
9/20/13	**Pool**	8	14°	11.36	n/a
	Run	n/a	n/a	n/a	n/a
	Riffle	8	14°	41.67	n/a
9/26/13	**Pool**	6	13.5°	24.33	1
	Run	6	13°	44.27	0
	Riffle	5	12°	57.14	0
10/2/13	**Pool**	6	12.5°	15.27	0
	Run	5	12.5°	41.2	0
	Riffle	6	12°	50.38	0
10/10/13	**Pool**	6	13°	12.18	0
	Run	7	12°	43.34	0

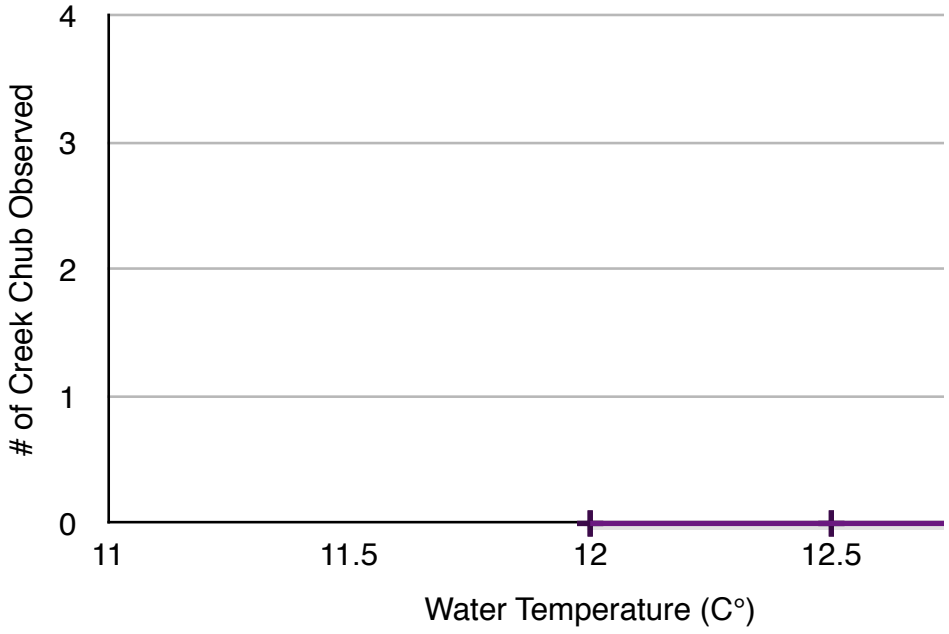
Date	Location	D.O (ppm)	Temp. (C°)	Water Speed (cm/sec)	# of Creek Chubs Observed
	Riffle	6	13.5°	53.35	0
10/18/13	**Pool**	6	11.5°	12.23	4
	Run	6	12.5°	41.24	0
	Riffle	6	12°	59.28	0
10/24/13	**Pool**	6	12.5°	14.35	0
	Run	6	12°	40.88	0
	Riffle	6	12.5°	57.25	0

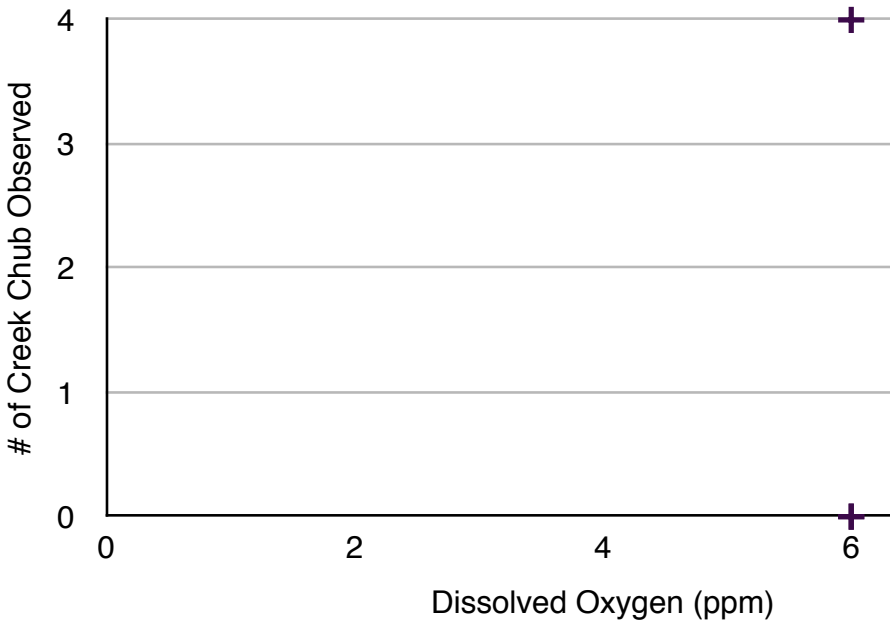
Calculations: The researchers calculated water speed by timing how long it took for a small stick to flow a meter in length on the surface of the water, then divide 100 by the time to get cm per second. Researchers also took two to three measurements of water speed, then calculated the average by dividing the sum by the number of samples taken.

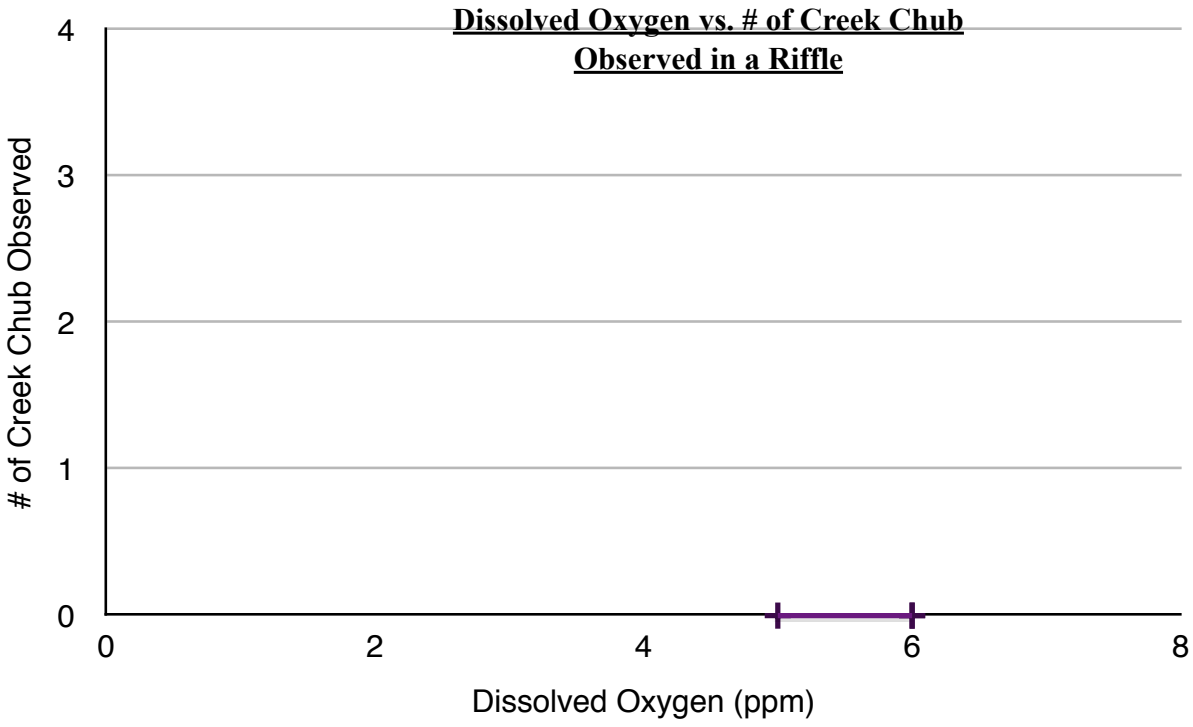


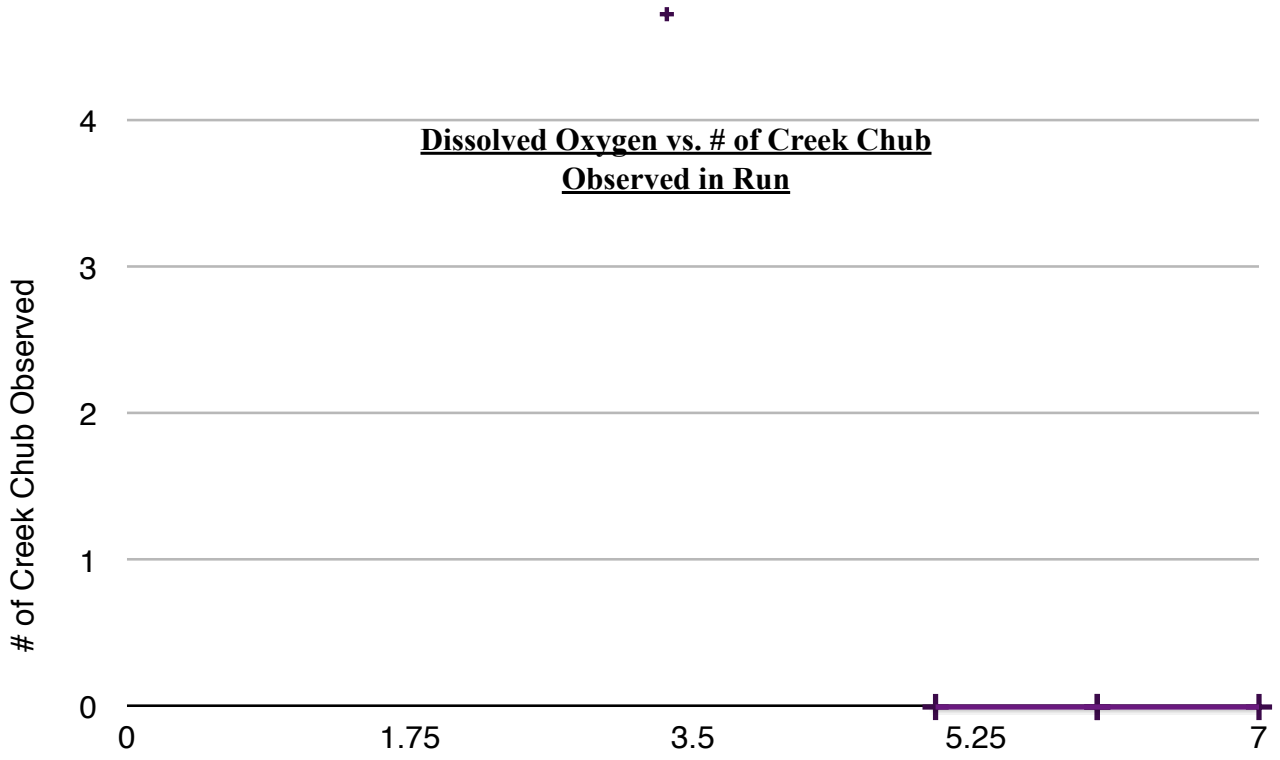
Graphs:


# of Creek Chub Observed
4
3
2
1
0
11
11.75
12.5
13.2
Water Temperature (C°)

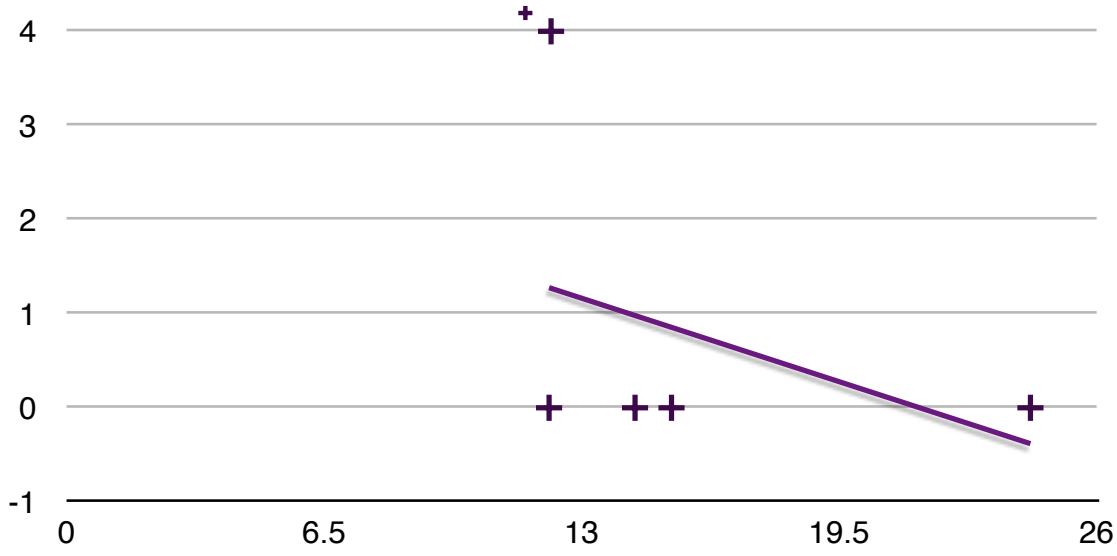

# of Creek Chub Observed
4
3
2
1
0
11
11.5
12
12.5
Water Temperature (C°)


# of Creek Chub Observed
4
3
2
1
0
0
2
4
6
Dissolved Oxygen (ppm)

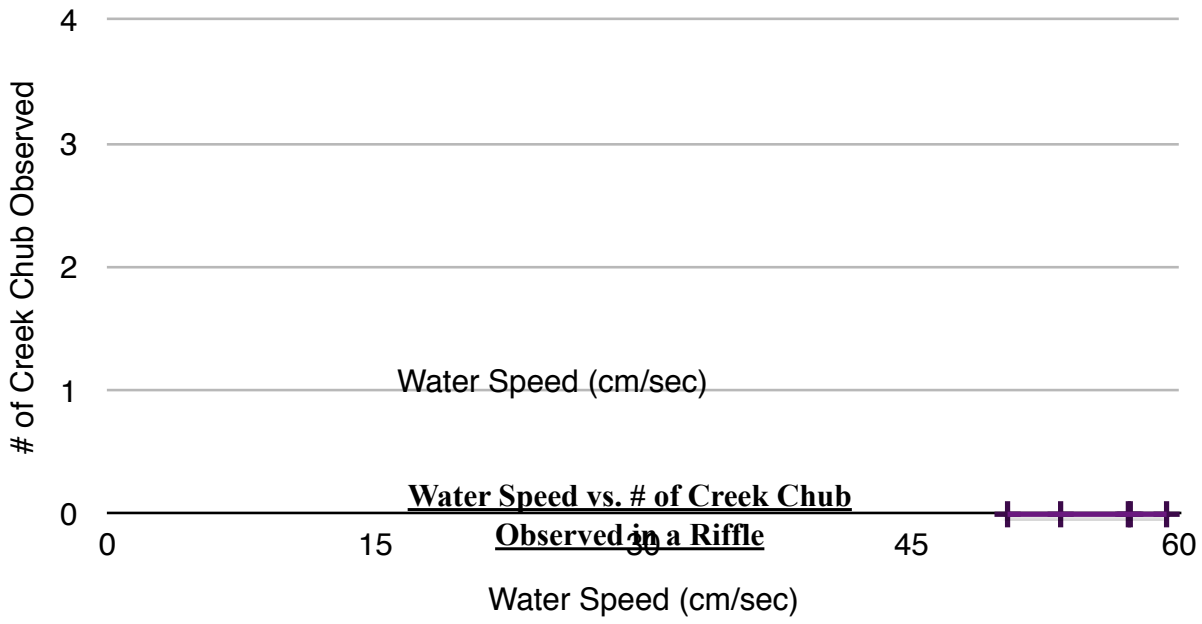

Dissolved Oxygen vs. # of Creek Chub Observed in a Riffle
# of Creek Chub Observed
4
3
2
1
0
0
2
4
6
8
Dissolved Oxygen (ppm)



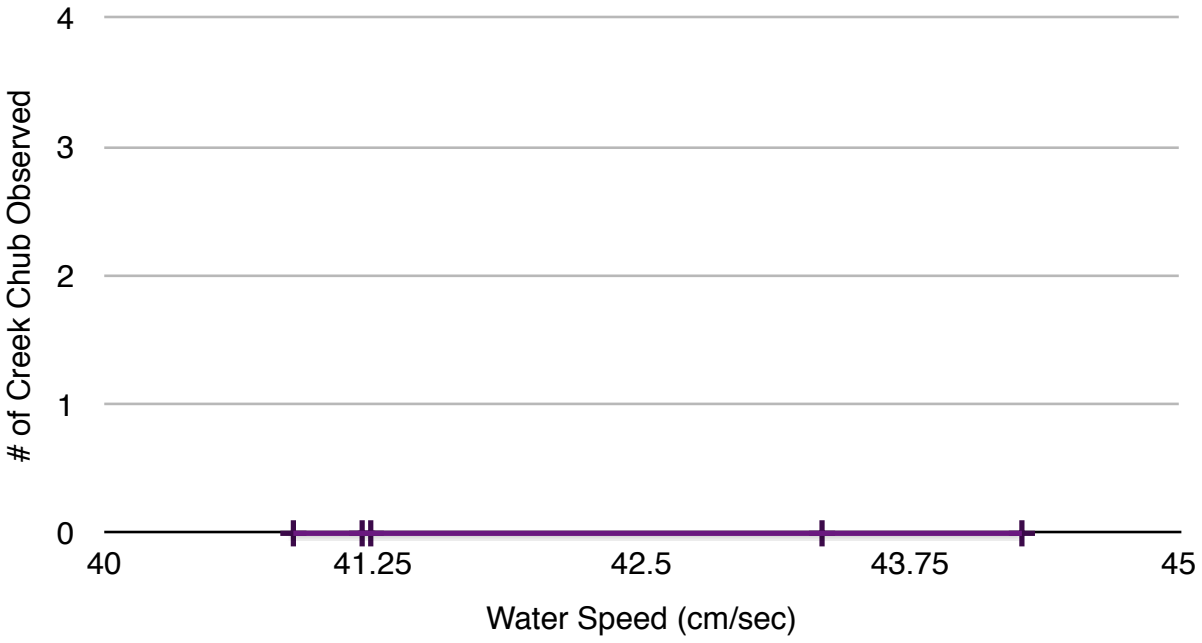
Dissolved Oxygen (ppm)



Water Speed vs. # of Creek Chub Observed in a Pool



Water Speed vs. # of Creek Chub Observed in a Riffle



Water Speed vs. # of Creek Chub Observed in a Run

Analysis: In the three locations, the researchers took three abiotic factors: dissolved oxygen, water temperature, and water speed. The dissolved oxygen ranged from 6ppm to 8ppm in the pool, 5ppm to 7ppm in the run, and 5ppm to 8ppm in the riffle. The water temperature ranged from 11.5°C to 14°C in the pool, 13°C to 14°C in the run, and 12°C to 14°C in the riffle. The water speed ranged from 11.36cm/sec to 24.33 cm/sec in the pool, 40.88cm/sec to 44.27 cm/sec in the run, and 41.67cm/sec to 59.28cm/sec in the riffle. Also, in the three locations the researchers used two techniques to try and observe fish. The first technique was with an underwater GoPro camera. One researcher would wade in the water with the camera and record for seven minutes. At the end of the day, the videos were downloaded onto a laptop and were analyzed. That method was very inaccurate, so the researchers tried a new one: netting. Netting is a technique that involve a seine net that is stretched across the river. This method worked better because more creek chubs were caught and observed. Only one fish was observed using the camera technique, and it was in the pool. With the seine net, four fish were caught also in the pool. Fish were never observed in the run or riffle. When fish were caught with the seine net, it was very helpful to the researchers because they could physically observe them instead of locating them on a video screen. The researchers could see the colors and size of them. There was not enough data to properly analyze the hypotheses. In order for it to work, the researchers would have to use the same technique everyday and observe fish on most days. Instead, the researchers used two different techniques and only observed fish on two days. The hypothesis was neither right nor wrong because it was not tested correctly. However, limited data from the pool suggests that fish can be found in water where the temperatures are between 12.5°C and 13.5°C, the dissolved oxygen level is 6, and the water speed is 12.23 and 24,33 centimeters per second.

Conclusion:

a. Over the course of six visits to the Cathance River, the researchers observed a total of five creek chub. The first creek chub was observed on September 26th with the GoPro camera, and the other four were observed October 18th with the a net. The abiotic factors that were collected in the water were dissolved oxygen, water temperature, and water speed. The dissolved oxygen ranged from 6ppm to 8ppm in the pool, 5ppm to 7ppm in the run, and 5ppm to 8ppm in the riffle. The water temperature ranged from 11.5°C to 14°C in the pool, 13°C to 14°C in the run, and 12°C to 14°C in the riffle. The water speed ranged from 11.36cm/sec to 24.33 cm/sec in the pool, 40.88cm/sec to 44.27 cm/sec in the run, and 59.28cm/sec to 41.67cm/sec in the riffle. Limited data from the pool suggests that fish can be found in water where the temperatures are between 12.5°C and 13.5°C, the dissolved oxygen level is 6, and the water speed is 12.23 and 24.33 centimeters per second. The hypothesis states that the abiotic factors affect the number of creek chubs observed. It would be inaccurate to apply this hypothesis with the amount of creek chubs the researchers recorded because there were not enough fish consecutively observed to do so. In

order for this hypothesis to work, then the researchers would have to observe creek chubs most times out of the six, and use the same technique every time. Unfortunately, this did not happen, because the researchers only observed fish twice out of the six visits, and used different techniques. Instead, it would be correct to say that the techniques used would affect the number of creek chubs observed. The researchers only used two techniques to observe fish because they were the only two available to them: the video recording technique, and the netting technique. To record underwater, the researchers used a GoPro. Out of the five fish, only one creek chub was observed using this technique. When looking at the video, it was hard to tell that the fish was a creek chub because it went in and out of the frame very quickly. The GoPro is an inaccurate way of observing fish because it have a very small field of view. It is also inaccurate because if the camera is put too deep in the water, then light cannot penetrate far enough to reach the camera, resulting in a very dark image. That is a problem because the bottom of the river is the most important place to record, since it is where creek chubs like to swim. The netting technique worked much better because more fish were able to be observed. Unfortunately, the researchers were only able to use the netting technique twice because they did not have help the other four times, considering it was at least a four person job. The first time, the researchers caught four creek chubs in the pool. They netted the run and the riffle too, but none were captured. The second time, no fish were captured. The researchers weren't surprised by the lack of fish in the riffle and run, but were when none were captured in the pool. This technique was much more effective than the other because you could physically observe the creek chubs instead of visually observing them on a computer screen. When the researchers captured the fish, they got to look closely at the variety of colors of their scales, and measure them. The size of the four creek chubs that were captured that day were 11.5cm, 12.5cm, 10cm, and 10.5cm. The measurement of the creek chub caught on camera cannot be recorded because there is no way of telling it's size on a screen.

No creek chubs were ever observed in the riffle or the run, only in the pool. The researchers think that is because the riffle is too shallow for the fish to pass through. The researchers think that none were observed in the run because it moves too rapidly for the the camera to catch any footage. Also, because bottom is too rocky to get the net completely to bottom of the river floor, giving them an opening to swim under since they like to swim near the bottom. The researchers think the most fish were observed in the pool because it is the easiest calmest place to record them, considering the water speed was mostly in the lower teens. The researchers also think that the pool was most populated with creek chubs because there is no strong current pulling them downstream. The creek chubs like to stay in the pool because it is where all the food get deposited. The pool was also the easiest place to capture the creek chubs because the bottom of the river was not rocky, so they couldn't escape under the net.

b. The second time using the seine net, the net was ripped because it got caught on a large stick in the water. For a while, the researchers had to pull at the net to free it. Eventually, the net ripped, so fish may have escaped through the tear. This may have cause the researchers to capture fewer fish than they originally would have. Another error was with the camera. It was not

time efficient nor was it accurate. The researchers were lucky to have seen one fish because it is not a good technique.

c. To improve the experiment, the researchers could have used more accurate capturing techniques, which would likely result in more fish being caught. If given more time, researchers would be able to do more complicated, accurate techniques (such as electroshocking and more intricate seine netting) multiple times, which would have give a better chance of observing creek chubs. The experiment would also be greatly improved by an increased amount of help from mentors. Help was received by fish experts very late in the experiment. Seine nets and expert knowledge was only available to the researchers for two of the six weeks at CREA.

Citations:

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Tomas E. McMahon. *"Habitat Suitability and Index Models : Creek Chubs."* Fort Collins, Colorado, 1982.