Gulf of Maine Research Institute Findings from the Field vol 2 Jun 2019

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**Note from the Editors**

Volume 2 of **Findings from the Field** was produced by a community of student scientists from 17 classrooms from 14 middle schools across Maine. Students engaged in and collaborated around authentic and locally relevant investigations resulting in 98 submissions to **Findings**. The effort continued through critical peer review as each submission was reviewed by student peers from another school. As the result of the collaboration of this community of students, their teachers, and this editorial board, we present to you Volume 2 of **Findings from the Field**.
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The good, the bad and the muddy
2018 - 2019

Dylan And Jett

Islesboro Central School
Islesboro, ME

Mr. Van Dis
5/17/19
Summary:
The purpose of this study was to find out if clams settle and survive on the mud flats on Islesboro. It was a comparison study using Beal Boxes designed by Dr. Brian Beal from the DownEast Institute. The town set out boxes in June 2018 at Ryder Cove, Sprague Cove, and Islesboro Harbor. The boxes were collected in December 2018 along with core samples of the mud beside the boxes. We counted and measured the clams found in the boxes and the core samples. We found that clam recruitment was significantly higher in the boxes. The study suggests that predation is a higher factor affecting clam recruitment, survival, and growth.

Question: Can clams survive in the Islesboro mudflats? If they can, which site is the best for recruiting and then planting new clams?

Introduction:
The people of Islesboro have been wondering why it’s been harder to find soft shell clams on the island. Recent studies have suggested that water temperature, water pH, and predation all affect shellfish survivorship, but which is affecting the clams on Islesboro? The Islesboro Shellfish Committee asked to be part of Brian Beal’s ongoing clam study. The Islesboro Shellfish Committee worked with Dr. Beal and island volunteers to set up Beal Boxes on three Islesboro coves last spring. The three coves were Islesboro Harbor, Ryder Cove, and Sprague Cove. The Shellfish Committee asked students from Islesboro Central School to helped collect, count, measure, and analyze the results from the study in an attempt to see how viable the mud here really is with the hope of finding out if it is possible to rebuild the clam fishery here, or are water conditions too unfavorable for clams?

In order to understand the factors affecting clam recruitment and survival, it’s important to know that water temperature, water pH, and predation all could be a factor for Islesboro’s clam flats.

Soft shell clams range in size up to three inches long. They have a surprisingly long life span, though they begin to reproduce at one year, they can live up to 10-12 years (Newell and Hidu, 1986). “Male and female clams reproduce by releasing their egg and sperm into the water column. Over the course of three weeks, the microscopic free-floating larvae develop shells and settle to the bottom” (Newell and Hidu, 1986). The first year of the soft shell clam is the most important because the clams are small and have lots of predators. The most common predator for the clams are the green crabs and the native milky ribbon worms which are increasing rapidly. “The typical female clam from 60-70 mm reproduce from one hundred twenty thousand to three million eggs a year depending on the location of the clam. The typical survival rate is point 1 percent which is one out of 1 thousand.” (Newell, 1986).

In 1998 the European green crabs were formally recognized as an Aquatic Nuisance Species by the Federal ANS Task Force (“Aquatic Nuisance Project Fact Sheet”, n.d.). That same year Washington State made it illegal to possess or transport European green crabs. It is a prohibited species in Oregon and California. In Alaska there are no fish and game laws barring importing live green or mitten crab into the state for the live food market. The green crab is a invasive predator mainly feeding on shellfish such as Soft Shell Clams, Oysters, and Scallops. The female
crab grows an egg sack 1-2 months after fertilization. She carries the egg sack for several months and then the eggs hatch into free swimming larva. The larva will stay in the water callum for 17-80 days. An adult green crab can release up to 165,000 eggs! The green crab lives for 3-5 years, releasing hundreds of thousands of eggs (Beal, et al., n.d.).

![Graph showing soft-shell clam landings from 1965 to 2015.](Plate 2)


Figure 1

The graph shows that landings were high in the 1970s and 80s, and then quickly dropped in the 1990s. It’s stayed pretty much the same since then. Since the 1980s, sea water temperatures in the Gulf of Maine have increased faster (0.03 C/year) than the global average rate of 0.01 C/year (Beal, 2015). Green crabs have been following the waters up the East Coast and like the warm waters. They grow and reproduce faster in warmer water which may explain the reason why the clam landings have dropped since the 1980s - there are more crabs eating more clams.

Water temperatures -
Warmer temperatures may not have a direct effect on clam growth and survival, but the warmer temperatures have an indirect effect. As previously stated, green crabs are adapted to warm waters which results in greater predation pressure on clams as the water around Islesboro gets warmer.

Ocean Acidification
Ocean Acidification is a decrease in the oceans pH. The ocean isn’t actually acidic, it’s less basic than it has been for the previous thousands of years. (“Ocean Acidification”, 2019). It’s caused by an increase of carbon dioxide. 30-40 percent of ocean acidification is caused by
human activity releasing carbon dioxide, primarily by burning fossil fuels (“Ocean Acidification”, 2019). As carbon dioxide levels in the atmosphere increase, more and more CO2 is dissolved in the ocean. Carbon dioxide dissolved in water form carbonic acid, lowering the pH of the solution. Lowering pH has the effect of reducing the amount of calcium carbonate dissolved in the water. Shellfish like clams need this carbonate to build their shells. When there is less available calcium carbonate, they grow at a slower rate and have to put more energy into developing shells which also slows their development. Right now, ocean pH is about 8.1, an increase of over 30% acidity since the start of the Industrial Revolution. Clam recruitment and survival on Islesboro mudflats might be related to this changing pH.

**Methods**

Using the Beal Box design developed by Brian Beal at The DownEast Institute, The Shellfish Committee placed 5 boxes at 3 tide levels at Ryder Cove, Sprague Cove, and Islesboro Harbor on May 20, 2018.

The dimensions of the boxes are 3 ½in tall, 2ft long, and 1 ft wide that has a screen on the top and bottom. The planktonic clams (baby clams) settle down from the water column and go through the screen into the box where they settle into the mud. That allowed a comparison of clams surviving in the mud to those protected in the boxes. Then, on December 20, 2018, we collected the boxes and core samples at the same locations. The core samples were taken by sticking a #9 coffee can into the mud, providing a plug of mud. The Beal Boxes and core samples were washed and screened to remove mud and debris. The clams for each sample were placed in a ziplock bag with a tyvek tag noting the location, tide level, and sample type (box or core). Students at ICS counted and measured the clams in each box and core sample from the three mud flats, also taking note of crabs and other species found. The results were entered onto a spreadsheet and uploaded to TuvaLabs for analysis. We needed to compute the number of clams per square foot (density) because there different number of boxes collected at the different
locations. Just finding the total number of clams wouldn’t take into account the number of samples.

If water quality is the limiting factor for clam recruitment and survival, we wouldn’t expect to find clams in the protected Beal Boxes. However, if it were the predation pressure of the crabs causing a decline in clam numbers, we would expect to find more clams in the Beal Boxes than in the mud core samples beside the clam boxes.

Clam and crab counts, measurements, and sample location were recorded on data sheets and entered into a spreadsheet on Google Suites. We tabulated the data and uploaded that to our TuvaLabs account for making the graphs and charts included here.

Results
The Beal Boxes did not all survive the 9 months in the water. Only 5 boxes were retrieved from Islesboro Harbor. 15 boxes were collected from Ryder Cove, and only 2 boxes were retrieved from Sprague Cove. Several boxes were intact but with crabs inside the boxes, two of which were boxes with crabs larger than 15 mm.

Here are our graphs representing the data from the investigation.

Figure 2

This chart shows the comparison between clams found in the mud and clams found in the Beal Boxes. Clams in the mud and boxes were all exposed to the same water conditions, but the clams in the mud had no protection from predation. The chart shows that very few clams were found in the mud core samples while hundreds of clams per square foot were found in the protected
boxes. It’s interesting to note that the shortest bars in the “Clams per square foot in Boxes” category correspond to boxes that had crabs larger than 15mm in them.

**Figure 3**

Figure 3 investigates the effect large crabs have on clam numbers in the boxes, explaining the short bars shown in Figure 2. The median number of clams in boxes without large crabs is 143 while there is no median for Sprague Cove because only one box was intact.

**Figure 4**
Figure 4 compares how many clams were found at the three sites. Ryder Cove has the most clams per square foot with a median of 148.5, Islesboro with a median of 93.5, and Sprague Cove with a median of 0. Results for Sprague Cove don’t have a calculated median because only one boxes were found intact at the end of the study. There is more variation in the clam count in Ryder Cove than at Islesboro Harbor.

![Figure 4: Clams per square foot in protected boxes at each tide level](image)

**Figure 5**

Figure 5 compares the number of clams per square foot at the different tide levels in Ryder Cove. Clearly low tide had the highest density of clams. This makes sense because clams are filter feeders and this section of the flats is underwater longer than the other levels. It’s interesting that the high tide group has a slightly higher density than the middle tide level group. Perhaps the slope of the flats is low enough that the mid and high tide levels have similar time underwater.

**Discussion**

Analysis of the clam samples suggests that water temperature and quality are not limiting factors for clam recruitment and survivorship on Islesboro as there were clams found in every intact Beal Box. There was a measurable difference in survivorship when predation was controlled for with the protection provided by the Beal Boxes. Figure 1 shows the difference in clam counts between the unprotected core samples and the Beal Boxes for each Site. Some crabs settled into the boxes along with the clams and Figure 2 shows the effect of large crabs (> 15 mm) on clam counts. As shown in Figure 3, there was no significant difference in average clam size for the boxes on Ryder Cove and Islesboro Harbor, though there were much fewer clams found at Islesboro Harbor because several boxes had washed away. Finally, Figure 4 shows the effect tidal level has on clam counts, suggesting that the low tide line has more survivorship.

**Next Steps**

We will work with the Shellfish Committee this spring to put out 30 Beal Boxes out in Ryder Cove in June, then collect them in December. We will put ten Beal Boxes at each tide level as was
done in this study. Then we will keep them over winter and plant them back in the mud flats the following spring. This will help us see if the clams will grow when we put them back in the mud flats because as of right now all the clams we have collected are small. The Shellfish Committee plans on providing some sort of predation protection to prevent crabs from eating these juvenile clams. A concern is that at Ryder Cove there were also a lot of mussels, and razor clams. That could mean that there is a lot of competition there with the clams, mussels, and razor clams. Now our next step is to figure out a way to make the clams survive by predation control using techniques practiced in Freeport.

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The Calvin Project  
Adams School, Castine Maine  
North Atlantic Right Whale  
Mr. McWeeny, Advisor  

White Belly Dominance Investigation  
By Student Scientist Charlotte G.  

**Introduction**  
Since I’ve started to research the North Atlantic right whale, I’ve come across information about white and black bellies on the right whales. In September of 2018, I joined an organization called ‘The Calvin Project’. The Calvin Project is a group of 7th and 8th graders who want to save the North Atlantic right whale. We are named after a whale called Calvin. Calvin is a North Atlantic right whale who’s mother, Delilah, was hit by a ship and was killed eight months after Calvin was born. After that, Calvin disappeared. Scientists thought she wouldn’t make it. But, a year later, she showed up the same place her mother was killed, which was the Bay Of Fundy.(A whale feeding ground.) Since I’ve been apart of the Calvin Project, I realised how much I loved researching these whales and how much I want to be a marine biologist. So, I decided to ask this question and see if I’d be able to answer it, are white bellies on whales a dominant trait or a recessive trait? What I mean is, are white or black bellies even passed down from generation to generation? I’ve been researching this topic for a few weeks, and I’ve found out a lot more about the topic then I thought I would.
Observations

I am doing a project using data already collected about right whales. I am making observations of the data which is sometimes called a metadata analysis. The observations were made on research vessels from 1980 to 2017. The environment was the Atlantic ocean along the east coast of the United States. Most of the observations were made on good weather days using high power cameras to document right whales features. The feature I am studying is white or black bellies of whales. The other data I used is genetic information about the whales. This information is collected at sea also. The research team darts a whale with a hollow arrow tip from a crossbow that collects a small piece of skin from the whale. That skin is then analyzed for sex and other things in a laboratory in Canada at Trent University. So, I did my “observational” research during the hours of 11:40 A.M. - 2:00 P.M. in my school’s science room/lab. I mostly used pen and paper, but I also used my school computer to count and record my observations of the data from the Right Whale Consortium. But before I could start my research, I had to get approval to use the data charts that scientists made at the New England Aquarium. I submitted a data request and received approval. The data charts had a lot of information about all the
567 North Atlantic right whales that have been studied to date. The information I needed was the whale’s gender, what year it was born, who the mother was and who the father was, and most importantly if the whale has a white belly or not.

**Background Information**

The question I was researching is, “Is the black bellied trait dominant or recessive in North Atlantic right whales?” I read a 1999 paper by Cathy Schaeff about ventral skin color in right whales. She assumed that black bellies were dominant but had no proof. She also thought the ventral skin color trait was not a sex linked trait. So my other question was, “Is the belly color trait sex linked?” Finally, Schaeff concluded that the ventral color patterns in right whales had something to do with an evolutionary process. I thought it was interesting that when Ms Schaeff wrote her paper she had no information about fathers, she only had mothers and calves. Now, twenty years later I have access to the father’s information also. I should have been able to prove dominance with this information.

![Picture # 1](image)

**Claims and Analysis**
I made a ton of three-whale family trees that look like picture #3. I wanted to observe how many families had two black bellied parents and a white child, or two white bellied parents and a black child. I thought I would find at least one family tree where the two parents were the same trait and the child was a different trait. If I found just one family like that I could prove which trait was dominant (See a proof of black belly dominance in picture #3). There were more black bellied whales than white bellied whales, but that does not prove dominance and I wanted proof.

My data analysis was very interesting even though it did not include proof about which trait, black or white, was dominant. I made 27 small family trees and not one family tree had two parents the same trait and a child of a different trait. This was very, very frustrating! The observation I was looking for was not found and I could not answer my basic question. But Mr. McWeeny pointed out that zero is an important number in the science community. I shared this information with Amy Knowlton, senior scientist at the New England Aquarium who studies right whales and she was quite surprised. She said that with all the families and not one like pair having a different child would show that the whale parents are not selecting mates randomly. It would be statistically impossible for the whales to be selecting each other randomly and not to have two parents the same with a different child. I did discover something after all. This shows that right whale parents seem to be selecting mates on their belly colors which would be more evidence that some kind of evolution is going on in the right whale population! Very exciting. More work needs to be done on this, and I would love to work on this subject.
My work also included just counting the total number of males and females that had white and black bellies. My numbers are shown in the table below:

Males white: 49   Males black: 108   Females white: 41   Females black: 86

These numbers show that there are no differences in sex when it comes to belly color in right whales. If belly color was sex-linked in right whales then you would expect one sex to have “twice” as many black or white bellies as the other.

I also thought that maybe white bellies were a sex-linked trait, which means a certain trait is more common in one gender than the other. We took the numbers of the whales that we put on our charts (409 out of 567) and did the math, and concluded that they are just as common in females as males. So it is not a sex-linked trait. The percentages show no difference:

Males black: 69%  Males white: 31%  Females black: 68%  Females white: 32%

**Conclusion**

Our results were inconclusive. We tried to prove either black or white bellie’s dominance, but we couldn’t find at least one family tree to prove it. We also tried to find out if white or black bellies are a sex-linked trait, and we were able to conclude that white/black bellies are not a sex-linked trait. Amy Knowlton, a scientist at the New England Aquarium, suggested that since there are no two black bellied parents and a white bellied child or the other way around, the females are choosing who they mate with depending on belly color and that might be an evolution process.

REFERENCES:

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North Atlantic Right Whale Catalogue, New England Aquarium, Central Wharf, Boston, Massachusetts.

Picture #1 Below:

If black bellies are dominant, it would make sense because even though the two parents have a black belly, they could still have been carrying a recessive trait.

If white bellies are dominant, it would not make sense because the parents would not be able to have a hidden dominant trait because then they would just have a white belly.
Hemlock woolly Adelgid is Now Invading Old Orchard Beach
Kailee M & Madison S
Loranger Memorial School
Teacher: Mrs. Nye

Abstract
Our goal was to find out if hemlock woolly adelgid (HWA) had spread to Old Orchard Beach Maine. The 7th Grade GT science group went out into Milliken Mills South to look for HWA. Our method was to find a hemlock tree that had at least ten branches that we could reach. Then we checked the ten branches for HWA or what was left over from them. We found that it had in fact spread to Old Orchard Beach.

Introduction
We are investigating HWA in Milliken Mills South, a forest in our town of Old Orchard Beach. We went out on November 30, 2018, to see if we could find HWA in Milliken Mills woods. Before we went out, we had to learn about what HWA is, what it looks like, and where it would be.

Hemlock woolly adelgid (HWA for short) is an invasive species, not native to Maine. HWA is an insect from East Asia that hitchhiked here on ships. On the east coast, scientists first found HWA in Virginia in 1950. Since then, it has spread from Virginia along the east coast to southern Maine.

We needed to know what a hemlock woolly adelgid looks like before we went out to look for it so we could better identify it. HWA has three stages in its life. It starts out as an egg which is roughly 0.25 mm long and 0.12 mm wide. Then it’s a nymph, and then it’s an adult. The adult is about 1.5-2 mm long and looks like a tiny brown flea and is usually hard to see. The nymph is less than 1 mm long or about the size of a pencil dot. You don’t usually see the adults because they are concealed under their white waxy cover produced by female adults. The waxy covers are formed on the underside of a branch, at the base of the needles. The cover can hold up to 200 eggs. It looks fluffy because of how many eggs it holds. We were looking for the leftover waxy cover because we were looking later in the year after the eggs hatched.

Our investigation is important because HWA kills hemlock trees and has negative effects on the ecosystem. Scientists already know that HWA is spreading in Maine. Data on CODAP told us where HWA was in Maine up to 2017. The closest town that had it was Saco, which is our neighbor.

We wanted to find out if HWA is in Old Orchard Beach. We thought we would find it because it had been found near us, and we know it spreads. The data we collected in
Milliken Mills South (MMS) will contribute to scientist knowledge of where HWA is and maybe we can figure out what to do about it.

Methods
The first thing we did was find an Eastern Hemlock tree. We then marked it with the orange marking tape so we knew what tree was ours. We took four photos to show that it was a Hemlock tree. We had to take a photo of the entire tree, a close up of the trunk, the underside of the needle, and the connection between the needle and the branch. We had to make sure that the tree had ten branches in reach. Then we checked the branches for HWA. Then Mrs. Nye double checked them. If we found it or not we took a picture of the number of the branch and the underside of the branch. We adapted the procedure by marking each branch with the orange marking tape so we would not check the branch more than once. We wrote down if it had HWA or not for each branch, on our data sheet.
Results

On the tree that we checked, we found that HWA had been on five of the ten branches. We only found one or two egg sacs per branch. Our graph shows data points from zero to ten for everyone who looked for HWA at that site. The average was 2.8, the data ranges from 0-5. The mode is five, the median is three. Our photo shows what was left after the HWA had been on the tree. We had no outliers.
Conclusions and Discussion

In conclusion, hemlock woolly adelgid was found in Old Orchard Beach. HWA is affecting forests in our region by killing the eastern hemlock trees. We need the hemlock trees to sustain a lot of the wildlife in our state. We think Milliken Mills has a mild infestation because we only found HWA on seven out of the ten trees we checked, and not a lot on each tree. Out of the seven trees our program checked, we found HWA on 2-5 branches. There were no trees we looked at that had it on more than five branches out of the ten we checked on each tree. Several factors may have influenced the data. There could have been more HWA, but the protocol told us to only check ten branches per tree. My group only checked one tree. We didn’t see the fifth, sixth, or eighth grade trees. We have to trust their data. We only checked a small percentage of the trees in Milliken Mills. That’s important to know because there are many hemlock trees we did not check. We could go back and check trees we did not get to. Collecting more data will give us a better idea of how severe the infestation is in Milliken Mills.

Bibliography

- [https://ento.psu.edu/extension/factsheets/hemlock-woolly-adelgid](https://ento.psu.edu/extension/factsheets/hemlock-woolly-adelgid)
Abstract
We have been investigating Hemlock Woolly Adelgid (or HWA) along with many other people and scientists all over the east coast. The area we investigated was Milliken Mills South, in Old Orchard Beach, Maine. We’ve gone only once, in late fall/early winter. We did find HWA in the woods. HWA is an invasive species, originally from Asia. HWA was first recorded in the USA in Virginia in 1920. So far it has spread from there, south to Georgia, and north to Southern Maine.

Introduction
We are investigating Hemlock Woolly Adelgid (HWA). The following information is from the Vital Signs species ID card. HWA are small insects that infest eastern hemlock trees. HWA has a long mouth tube that they insert into the tree to get sap. They lay their eggs and cover them with a waxy tuft-like substance, which is what we searched for out in the forest. They lay their eggs on the underside of the branch right where the needle connects to the branch. HWA is called ‘woolly’ because their egg sacs/coverings are a white waxy substance that looks woolly or fuzzy. The insect itself is not woolly, they are tiny nymphs, and are a dark brown or black color.

The Hemlock Woolly Adelgid is an important investigation to our community, along with other scientists throughout the eastern USA. The hemlock trees provide shelter, food, protection, and shade for many species. We have a lot of hemlock trees and they are important to our ecosystem. We learned that HWA started in the south and has been making its way north and east. We
explored Maine climate data, and discovered that the winters are getting warmer. Warmer winters mean more HWA surviving the cold season.

Hemlock trees are coniferous evergreen trees that can grow up to 30m tall. The branches on the tree have more of a drooping appearance. The needles on the branches are alternately arranged and are 1.5-2cm long. On the underside of the needle, there are two white “racing stripes” and the needles connect to the branch with a “peg” rather than a “suction cup”. In the spring the hemlocks have flowers, the Male flowers are small and more yellow when the female flowers are small green cones that change into small brown cones.

Our research question is where in our area HWA is and where is it going next? This investigation is important because it helps out other scientists find out where HWA is and where it is moving in Maine. If scientists know what HWA is doing it could help them prevent them from infesting more trees and causing further damage. Originally we thought we would find HWA in Milliken Mills because HWA had spread through most of southern Maine and later we found out we were correct.

**Materials and Methods**

We went into the Milliken Mills woods on November 30, 2018, to find an eastern hemlock tree, the branches on the tree had to be at least one meter long and it has to start from the trunk. We identified the Hemlock by turning the branch over and seeing if there were two “racing stripes” if the needles connected to the branch with a little stem and not a suction cup, and if the twigs and branches were more flexible. We used the iPad to take four photos of the whole tree, the trunk, a branch segment, and the close up of the needles. We then found a branch within reach to start observing. Once we found a good branch we turned it over to see if there was HWA. For each branch, we first took a photo of a label with the number of the branch. If there was HWA, we would take a clear photo of the specimen on the branch and if there wasn’t we just took a photo of the branch, using the clipboard as a solid color surface. We would then take the piece of the branch that had HWA on it. For every branch, we would record on our data sheet if there was
Findings from the Field

HWA or not. We did this procedure on 10 branches per tree, marking each branch with flagging tape and the branches number with the marker. We had an HWA guide sheet to ensure that what we saw was HWA and nothing else. The ruler that we had brought was not used but would have been used for measuring the length of the needles.

**Results**

Seven out of the ten trees in Milliken Mills South we looked at had HWA, three out of the ten trees in Milliken Mills South we looked at didn't have HWA, and one out of the two trees we look at as a team had HWA.

The first tree we looked at had two branches where we found HWA, the tree also had one branch where we couldn’t tell if it had HWA or if it was something else. The first two branches we looked at were the ones that had HWA, those two branches happened to be the lowest. It wasn’t very tall and it wasn’t as full as the others. This tree was also near a few more hemlocks and it was in a very shady area.

The second tree we looked at had no HWA on it, it was not near any other hemlocks, and it was in a very open, sunny area. The tree was very tall and wide, and unlike the other trees we looked at this Hemlock had small pinecones.

The range of the data was from 0-5, the mean of the was 2.8, the median was 3, and the mode was 5. The data is mostly clustered towards the lower end of the chart.
Findings from the Field

Chart

Tree 1

Branch 1, Tree 1

Branch 2, Tree 1

Tree 2

Tree 2 branch
**Discussion and Conclusion**

Based on the data that we found we can tell that Milliken Mills in OOB ME has a mild infestation of HWA. How we could tell it was mild was because 7 out of the 10 trees that we surveyed had HWA but each branch that had HWA only had one or two small spots. Also from looking at our data and the CODAP website we can predict that HWA will most likely keep making its way up north. Quite a few towns in northern Maine still haven’t done this investigation so HWA could possibly already be more northern than we may think. If more towns in northern Maine went out and did this investigation, our conclusion would be more accurate. Our class didn’t check every tree from each class so we have to trust that they were accurate and precise. The CODAP website has a map that shows where HWA has been found and where it hasn’t found. The map helped us the most with our research question because it showed where HWA could possibly be going next by looking throughout the years. In the first photo, it shows in some areas there are only yellow dots but in the second photo, it shows that some of those areas now have purple dots. After all of this, our question has been answered, we know that HWA is now in OOB and we can predict that it will keep moving more and more northern.

![Map Image](image)

*(2009-2017) Purple: found  Yellow: not found*
(2018) Purple: found    Yellow: not found

(OOB is not on the map yet because not all the data has been entered)

Sources:
CODAP
Vital Signs
Hemlock Woolly Adelgid (HWA) Found in Old Orchard Beach
Research Highlights Grade 6
Loranger Memorial School
Teacher Mrs. Nye

Results
Our research question was, How is HWA affecting forests in our area, including Milliken Mills Woods? When we looked in Milliken Mills Woods, we found HWA.

We looked at 4 trees and all the groups together looked at 10 trees. Each dot on our dot plot represents a tree. The x axis shows how many branches were infected with HWA. Our data shows that most groups found none or 5 branches with HWA specimens out of the 10 branches they checked on their tree. No 1’s were found, or 4’s. However, 5 was a very common data point, meaning that some trees had at least 5 branches infected with HWA. None of the data points extended past 5, despite most teams managing to examine 10 branches maximum. The median was 3 branches with HWA.
We looked at 2018 Vital Signs data on CODAP to see the data collected in 6 sites in Maine that did the investigation when we did. The graph shows 8 places but we know that Milliken Mills and Milliken Mills Woods South are the same and we found out that Mick Way and Dedham are the same. Three sites found HWA: Milliken Mills Woods, Robinson Woods and Lake Region Middle School. In Lake Region, 39 trees in all, 6 found, 33 not found. In Milliken Mills, 8 trees in all, 7 found, 2 not found. In Robinson Woods, 3 trees checked, 3 found it, 0 not found. Three sites didn’t find HWA: Dedham, JSMS, Castine.

We checked Vital Signs data from 2009-2017 on CODAP. We saw that 38 towns looked for HWA and most did not find any HWA. Five trees were checked in OOB with no HWA found.
We found a map on Maine.gov called HWA Detections in Maine’s Forests. The map shows everywhere in Maine (up to 2017) with HWA. This data shows that HWA in Maine is mostly on the coast. It’s in about 6-7 counties on the coast. When we zoomed in, we could see that HWA was found in OOB in 2013 and 2016.

We looked at a graph Winter Minimum Temperatures in York County Maine. This data shows the winter minimum temperatures in York County ME, from 1980 to 2018. The trendline rises from 13 to 18 degrees fahrenheit. They have gone up about 5 degrees in 38 years.
**Discussion and Conclusions**

We think that Milliken Mills Woods has a mild to moderate infestation of HWA. We are confident in our data because we've done research and have gone places and seen HWA. Our most common finding was a cluster of data at 5 branches having HWA. The maximum was 5 branches. The second most common finding was 0 branches. Our photos show one or two HWA spots or none on the branches. We wouldn’t have found so many branches with no HWA if it was a severe infestation. We didn’t check every branch or every tree, so there could be more or not. We think there probably are more infected trees but we don’t know. The trees looked healthy because they were intact and none were dead.

When we went to Ferry Beach State Park in Saco we saw a severe infestation of HWA and lots of dead hemlock trees because of it. The park is only about 3 miles away, so we know there is already a lot of HWA in our area. We know that one HWA has 22,500 offspring in 2 generations (Vital Signs species sheet). This means it can spread quickly. Also 50% of adults have wings so they can fly and infect more trees in the area. We have evidence from Vital Signs data and the Maine.gov map that HWA is being found in new places, so we know it’s spreading.

We know that HWA survives through the winter if it doesn’t get really cold, and we have evidence that the winter minimum temperature is going up so that means more HWA will survive through the winter. We predict that if we go back to Milliken Mills in the spring, we will find more HWA. Maybe the spots we saw will have nymphs or adults near or in them and the patches might be bigger.
The Maine.gov map shows that HWA was discovered in OOB in 2013 and 2016, earlier than Vital Signs. We think that’s because the Maine Forest Service data was collected by scientists and Vital Signs was collected by students. The scientists might have looked in more places. Both places where they found it are near Goosefare Brook, on the southern border. That is near Ferry Beach State Park, which has a severe infestation of HWA. We found it in Milliken Mills, which is in the northern part of OOB.

Our research indicates that Milliken Mills has a mild infestation of HWA now but it will probably spread and get more severe. Also we will probably find HWA in more places in OOB if we keep looking for it. Last year we made a flyer to tell people what to look for and what to do if they find HWA. This year we made a list of tips to tell people what they can do to treat HWA or slow it down. Homeowners have options like spraying trees with soap and water to knock off the adelgids so they will die on the ground. There is not much we can do in the woods yet except try to avoid spreading it. We are going to give our list to the Conservation Commission so they can share it with the public.

We want to ask the rangers at Ferry Beach State Park if needles can grow back after they fall off and if there are other solutions we can try. We wonder if HWA or hemlock trees can be genetically modified to stop HWA.
A Microscopic View of the Sea Water Around Us

Deer-Isle Stonington Elementary School 7th and 8th graders

Our study of plankton began with reading sections of *Sea Soup: Phytoplankon* (Cerullo 2003). On 30 April 2019 and 2 May 2019, we saw plankton for the first time. Our specimens were collected as described in Figure 1. We used a plastic pipette to put 5 drops of sea water onto a glass slide and we did not use cover slips. Then, we scanned the puddles on our slides back and forth with NASCO High School microscopes. Most of our observations were made using the low objective so the magnification was 40X.

We were totally amazed and surprised to see so many different, living things in five drops of water. The zooplankton were the little animals and they moved. Some of them were very, very fast and they darted across the view. Some of them were slow and some of them wiggled. The phytoplankton were the little plants and protists. They did not move and many of them were green. Many of the organisms were transparent and you could see everything from the legs to the insides. We drew pictures of what we saw (Figure 2) and we figured out how to use our phones to take pictures (Figure 3). What caught our attention was the strands that were not moving that were bright colors like red and blue (Figure 4). We wondered what those were.

Abby Barrows is a marine researcher and oyster farmer who lives here on Deer Isle. She visited our classroom on 1 May 2019 to talk about microplastics and how plastic is polluting the world (Barrows 2018). Most of the plastic is from stuff that gets used one time (PlasticsEurope, 2016). That’s what the blue and red strands on our slides were and we were on the lookout for them when we examined plankton the next day. We found many more examples when we knew what to look for. Also, Abby put filter paper in a Petri dish on the teacher’s desk and she used our SmartScope to examine it at the end of the 50 minute class. A piece of microplastic fell out of the air!

Many of us fish and some of us have been fishing since we were eight years old. We wondered what the microplastics were doing to the lobsters and clams, especially because now we understand lobsters and clams start out as zooplankton. What does microplastic do to them when they are small and then when they are big? If there is microplastic in the air and we are breathing it, where does it go? Is there microplastic in our snot? What we can’t normally see in the water and in the air impresses and worries us.

Figure 1. Collection Information

<table>
<thead>
<tr>
<th>Place</th>
<th>Date</th>
<th>Time</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls Bridge, Blue Hill</td>
<td>30 April 2019</td>
<td>0630</td>
<td>Plankton net</td>
</tr>
<tr>
<td>Mill Pond, Deer Isle</td>
<td>30 April 2019</td>
<td>0700</td>
<td>Plankton net</td>
</tr>
<tr>
<td>Falls Bridge, Blue Hill</td>
<td>2 May 2019</td>
<td>0600</td>
<td>Plankton net</td>
</tr>
<tr>
<td>Town Dock, Stonington</td>
<td>2 May 2019</td>
<td>0730</td>
<td>5L bucket with filter</td>
</tr>
</tbody>
</table>
Figure 2 Our Drawings of Plankton

Figure 3 Our Photos of Plankton
Figure 4 Our Photos of Microplastic

References

Marine environment microfiber contamination: Global patterns and the diversity of microparticle origins* A.P.W. Barrows a, b, *, S.E. Cathey a, c, C.W. Petersen
https://www.journals.elsevier.com/environmental-pollution 2018


Cerullo, Mary; 2003, Sea Soup: Phytoplankon; Teacher’s Guide; Tilbury House, Gardiner, Maine; Pages 8-10, 86-87
Teacher: Mickie Flores

Students:

Alyssa D.
Avie L.
Brayden M.
Brooklyn J.
Cassie S.
Chris S.
Cody H.
Colton H.
Devin D.
Daya W.
Gavin E.
Grace M.
Hallie H.
Hannah L.
Jarvis E.
John M.
Jonah B.
Jordan A.
Judson N.
Kara L.
Katie G.
Kianna H.
Kiersten H.
Luke G.
Macey B.
Maddy E.
Madison E.
Marlaina J.
Maya B.
Nataley L.
Owen S.
Riley H.
Sean M.
Taytum C.
Treben S.
Vanessa V.
Zander P.
Microplastic Investigation

By: Saydee G.

On April 30th, 2019, Edna Drinkwater School’s fifth grade went down to the beach to collect water samples to search for tiny plastic fragments. Microplastics are multiplying and being eaten by fish. The plastics are being broken down by waves and sunlight in our water. They are called microfibers and fragments. We collected from the Drinkwater Beach in Northport, Maine. The beach was part of the Penobscot Bay. The wind speed was two MPH and the temperature was 49 with a water temperature of 42.5 degrees fahrenheit. The weather was cloudy with zero percent precipitation that day. We took special care when collecting the samples to not go too fast or too close to the bottom as we didn’t want sand in our water. Once we successfully got our samples we headed back to the classroom.

Once we were in the classroom we set up our stacked 53 and 10 micron mesh sieves on wooden blocks to stop the water from flowing back into the filters. We waited two days for the water to drain into the bucket, then the seventh grade came on May third to help us look for microplastics in the filters. My group found 12 pieces of microplastics, and only two weren’t black which surprised me because we throw away a lot of soda bottles and soda bottles are usually clear or colored. I saw that there were many more fibers than fragments in the half of a gallon we used.

As you can see it’s interesting we found so much in just a half gallon of water. I just hope we found a good amount so that not many animals are eating it because plastic can smell and look just like food. Experiments show that plastic covered in algae attracts anchovies that eat it and get clogged stomachs, as well as turtles and other fish. Plastic can severely impact ocean ecosystems with fish eating it and starving.

In conclusion, there are microplastics in our water. I suggest an investigation about how much plastic humans consume each year and how it affects the human body. We may not be able to reverse our actions but we can try to stop throwing so much plastic away and stop killing ocean ecosystems.

Sources:
- Stewards of the Sea (Pacific Marine Mammal Center)
- Tiny Plastic, Big Problem by Alison Pearce Stevens
- Why Animals Can’t Stop Eating Plastic by Josh Gabbatiss
- Food-like scent in some plastic trash lures fish new study shows by Los Angeles Times
- WeatherBlur (Maine Math and Science Alliance)

Nature Note
Edna Drinkwater School
Teacher: Abby Plummer
HWA found in Jameson Woods, Old Orchard Beach
Loranger Memorial School Nature Note
Teacher: Mrs. Nye

Hemlock Woolly Adelgids (HWA) are an invasive species that uses Eastern hemlock trees as hosts for their food source and nesting. Their young suck the sap from the base of the hemlock needles, slowly killing the tree. On April 22, 2019, we found HWA in the forest behind Jameson Elementary School. We knew it was HWA because it had its distinctive white egg sacs. The HWA was on the underside of the hemlock branch at the base of the needles. There were only a few egg sacs so we believe it’s just starting and will spread up the tree. It will kill the tree in 4 to 10 years depending on how fast the HWA spreads. We learned this from the rangers at Ferry Beach State Park.

We predict the HWA will spread because there was a decent amount of hemlock around and quite a few carriers. Carriers are things that can spread HWA to different locations. Animals as well as abiotic factors of the surrounding environment can be carriers. An example of an abiotic carrier is wind, which can allow HWA to move from tree to tree. We heard birds and squirrels, which could potentially spread the HWA to different parts of the forest. A lot of people go into the woods since it is right behind Jameson School. The tree is on the main trail where people could easily pick up and spread the HWA by accident.

We could cut off the infected branch and put it in a bag to attempt to possibly resolve the situation, but we did not do that because we don’t want people to go around unintentionally harming hemlock trees. We do not want to use pesticides because the school is Pre-K to Second Grade. Pesticides could potentially be dangerous to humans,
so we have come to the conclusion to refrain from using them. The tree is flagged, allowing us to find it and check it routinely to see if the HWA has spread.

We were surprised to see HWA on the tree because that means the HWA managed to live through the winter. This is surprising because HWA doesn’t prefer colder temperatures. We learned this at Ferry Beach Nature Center. However, we know that winters are getting warmer due to climate change because we looked at data of past winters’ coldest temperatures from 1980-2017 in every county of Maine. The trend line rising in all the graphs shows that the winters are getting warmer, at least in Maine.

Usually rain and wind can take off HWA, but some stay on through the winter. Wind and rain could wash HWA off the tree, but with large trees, the branches act like a shield and protect the HWA. 50% of the adults are winged and can fly to another host. However, the other 50% don’t fly. If they stay on the tree, they can reproduce and proceed to kill the tree. In future years, we predict most of the hemlocks will die in the Jameson forest. Birds and squirrels use hemlocks for food and shelter. If all the hemlocks die, that will affect the animals living in the forest.

This is a drawing of HWA throughout its life cycle, drawn by our own Ih-Z G from Old Orchard Beach. There are 100-300 eggs in one tuft or egg sac.
“Is the salinity in the marsh affecting the alewives from reproduction?”

Our marsh is located in Tenants Harbor, Maine near the St. George School. The marsh flows into Ripley Creek which then flows into the ocean in our Harbor.

On Thursday, April 25th our class collected a water sample at 1:03 pm. One sample had a salinity of 0.27 ppt. It was collected in the marsh near the outlet dam. This salinity didn’t surprise me because I know that there had been seaweed in that area, which means the salt came in on a tide sometime earlier. Also, the past four days before, there had been bigger tides than that day which would have brought more salt in. The tide that day was 9.7 ft.

Since most of us were not expecting to find salt in the marsh, we think it must have came in on the spring tides. Spring tides are the highest of the high tides that happen when there is a full moon every month.

In the mid 1980’s, the alewives stopped coming back to the marsh. Alewives are usuallyrestocked for four years in a row, but starting in 2009 they restocked 500 fish for five years until 2013. In the spring of 2016, they found 30-40 fish in the culvert and netted 10 of them. There were no sightings of alewives in 2017. Though in 2018 there were two fish netted. Our observation of the salt water in the marsh is important because we think this could be a reason why the alewives are not coming back since they restocked.

This importance of this salinity sample is we think the salt in the marsh is what might be causing the alewives to not come back to the marsh, because alewives normally spawn in freshwater. For many years, many alewives returned to the marsh where they spawned. Then they stopped. The ocean water is where the salt has been coming from, because of climate change. The ocean water is coming in from storms, spring tides, and overflowing into the marsh. Four days before our sample was collected, the tide was 11.4 ft.

The question we are trying to answer is, “Is the salinity in the marsh water what is affecting the alewives from reproducing and growing our population of alewives?” Our way to answer our question will be to set up tanks in our classroom, as many as we decide on. Once we do that, we will fill each tank with a different amount of salinity, as well as having a freshwater tank, and we will put the same amount of fish in each tank. When all of the tanks are set up we will see how long each of the fish survive in each tank, depending on the salinity.

Tenants Harbor marsh  The dam at the marsh
Will The Alewives Return?

View of the marsh from the parking lot

Ripley Creek

The marsh in Tenants Harbor is down over the hill from St. George School and flows into Ripley Creek and into our harbor. The marsh is home to eagles, herring gulls, kingfishers, frogs, snakes and more. In the spring you see lots of birds and animals in and around it. A lot of people kayak in the marsh in the summer. The marsh is a beautiful and quiet place.

On April 25th, 2019, a Thursday afternoon at 1:03 PM, we measured the salinity on the inside corner of the dam. We measured a salinity of 0.27 PPT. The significant thing about this salinity observation is that we thought it was going to be zero. It’s a high salinity for what we were expecting as a result, since we have a freshwater marsh.

Our class’s observation of the salt water in the marsh is important because we are working with the town to bring back the alewives. Alewives have not been coming back to the marsh since 1986. During the years of 2009 - 2013 our town restocked 500 alewives each year in the marsh. Many towns get their alewife run going again by doing that with the state scientists. It doesn’t seem to be working for our freshwater marsh. So we are wondering if this salt water has something to do with the alewives not coming back, because alewives spawn in freshwater.

Our question is, “Is the salinity in the marsh affecting the alewives from coming back to the marsh?” We plan an experiment to answer this question with alewife eggs. What we are going to do is put different amounts of salt in each of our five fish tanks and put alewife eggs in each tank and see if salt can affect alewives’ survival. Our findings are going to get shared with the community, and we are hoping they will be useful for proving alewives can survive in our water.
Our marsh is located in Tenants Harbor near St. George School. You often see geese, ducks, gulls and other different species there. The marsh has become an important part in our classroom. On Thursday April 25th around 1:00 PM, my class went down to the marsh to test the salinity of the marsh. We have been going down to the marsh around once every week, testing the water in the marsh so we know what the salinity is. We wonder if it affects the adult alewifes spawning in the marsh.

When we tested the water we ended up getting 0.06 ppt, 0.06 ppt, and 0.27 ppt. What is so significant about the 0.27 ppt sample is that it is in our freshwater marsh and it is near alewife spawning habitats. The samples that we took were each sampled in different spots. On Thursday there had been a previous high spring tide that could be a reason why one of the water samples had a much higher content. At such a high tide water flows freely from the creek into the marsh, up over the little waterfall of the dam.

There have been very few alewives in our marsh ever since 1986, but then the state restocked our marsh with five-hundred alewives each year from 2009-2013. Other re-stocking efforts in Maine have been successful but not here in St. George, and we want to know why.

Our question is “Is the salinity affecting the alewives?” The experiment that our class is planning on doing to answer that question is to have five different fish tanks with alewive eggs and to put different amounts of salt in each tank to see if the alewive eggs are affected by different levels of salinity. We are hoping to share all the information that we have learned with our community. We hope that this information is useful for proving that alewives can survive.
Salinity Differences in our Marsh

My class goes down to the marsh just about every other day. The marsh is located in the town of Saint George, Maine, near the St. George School. The marsh is a quiet place. We see lots of birds, like geese, duck, osprey, eagles, and so much more. You can hear the sound of water trickling down the river, and the birds chirping. You can feel the warm sun shining on your skin, and the soft breeze lightly brush against your skin.

On Thursday, April 25th, 2019, at 1:03 PM, my class went down to the marsh. We go down to the marsh quite a bit to test the salinity and see the changes of salt. We measured the salinity of the marsh, and got a measurement of 0.27ppt (parts per thousand.) Our measuring site was near the dam, underneath a dead tree. There was some seaweed along the bank of the marsh, down by the cattail reeds.

This is the alewives spawning habitat. What we are wondering is, how is there so much salt in the marsh? We had 11 ft tides a few days ago, so I think that the salt water would have gotten into the marsh. I would have expected these results on that day, but not on a day like this. I was astonished, and slightly confused.

In the 1980’s, the town’s alewife run suddenly stopped. When the alewives disappeared, the state of Maine started restocking the marsh with alewives. That lasted from 2009 to 2013.

Lots of animals eat alewives. They are at the center of the food chain, which means many animals eat them. If the alewives were gone, then those animals wouldn’t have much to eat, then possibly die of starvation. People use alewives for lobster bait as well, so if alewives were all gone then fisherman would have to use different bait, such as pogies, pig hide, and herring.

Alewives only spawn in freshwater, and lately there has been more saltwater in the marsh. And if there is too much salt in the marsh, then the alewives won’t spawn. We want to measure the salinity and see the measurement, because that could be the cause of the alewives not returning.

We are wondering if a certain amount of salinity is influencing the alewives to leave. We will be taking some eggs from North Pond and the St. George run and put the eggs in tanks with different measurements of salinities and see if that may be the cause. One of my classmates made a probe that measures the salinity in the marsh, and we are going to see if we are correct, and find out if that may be the cause of the alewives not returning.
Salinity Change in the Marsh

Our marsh is just down the hill from the St. George School next to the Jackson Memorial Library. The marsh’s waters flow into Ripley Creek which flows into the ocean. In the bubbling, frothy water where the dam is, soon the alewives will return to spawn. Our freshwater marsh is a quiet calm place where we see all sorts of animals like kingfishers, osprey, eagles, herons, egrets, eels, other fish, turtles, geese, ducks and other animals. If I sit on the bank and look at the water, I hear water rushing, trees and twigs crackling and cars moving. I feel the sun on my skin, the cool wind, life’s energy everywhere! It used to be the home to alewives until the 1980’s when they disappeared and the run halted.

On April 25th Thursday 2019, at 1:03pm, our class took a very surprising salinity measurement of 0.27 ppt (parts per thousand) just inside the dam. There were big 11ft tides 3 to 4 days ago and we have seen some seaweed on the marsh side of the dam too, all the way past the “big rock” to the cattail reeds. There are flooding tides every month. This is the alewives spawning habitat.

In mid 1980’s, our town’s alewife run stopped. After they disappeared, the state of Maine started restocking the marsh with alewives from 2009 to 2013. In 2015, the old culvert was replaced because the alewives couldn’t pass through it because it was too high.

Alewives are at the center of the food chain which means almost everything eats them (other fish, lobster, birds, etc.) If there are no alewives, then lots of animals lose their food source. Alewives are great as lobster bait and many lobster men have to resort to other fish such as herring, pogies and even pig hide! There are some lobster men are still very concerned about what to use as bait, especially since herring are less plentiful now.

Since the alewives can only spawn in freshwater and if there’s too much salt in the marsh, their eggs won’t survive. We want to see what the salinity is and if that is the reason there aren’t many alewives.

We will be taking eggs from North Pond and the St. George River run and putting them in tanks with different salinities to see if a certain salinity is affecting the survival of the alewives. Also, a classmate of mine built a salinity probe to measure the salt in the marsh. We will be looking at the results and tell the town. I really really hope our marsh habitat can sustain the alewives for a good long time.
Salinity in the Marsh

The marsh is located down the hill from St. George School next to the Jackson Memorial Library the marsh flows into Ripley Creek. The marsh is home to eagles, gulls, kingfishers, frogs, snakes and more. Our class goes down to the marsh about once every week. It is a quiet and beautiful place to be.

Our class went down to the marsh at 1:03 PM on Thursday, April 25th to collect a sample of water to see what the salinity levels were. The salinity level we got was 0.27 ppt. The place we took the sample was in marsh. The type of weather on April 25th was sunny and a little bit windy.

The significant thing is that there is salt coming into the marsh each month with the highest tides, which could change the spawning habitat for the alewives. In the mid 1980’s the alewives stopped coming into the marsh. The state started to restock the alewives in 2009-2013, but we have only seen a few alewives in the past four years. We are not sure why the alewives have not come back since the restocking. We are worried about the saltwater that is coming into the marsh because we are thinking that it may affect the alewives eggs after spawning. Alewives normally lay their eggs in freshwater.

These observations make us wonder how much saltwater is coming into the marsh with the tides. Is that why the alewives have not come back? Because we have warming climate it is making the tides high enough for saltwater to come into the marsh.

We are going to try and hatch alewife eggs in different amounts of salt to see how much of an effect the salt will have on the eggs. When we figure out how the salt is affecting the alewives we would like to share our information with the town of St. George and maybe the town would consider restocking again.
St. George School  
Mrs. England, Mrs. Schmanska  
“Where are the Alewives?”  
Colby H.  
Nature Note  

“Where are the Alewives?”  

The St. George marsh is a very quiet, peaceful place. Water from the marsh runs into Ripley's Creek then mixes with the salt water. The beginning of the south side of the marsh starts off very linear then opens up into a very wide and almost oval shape area at the north side. You can find the St. George marsh just by looking up St. George School, Maine on Google Maps.

Back in the 70s and early 80s the marsh provided bait for lobstering. Everybody thought that alewives would always be there. But in 1984 or 1985 the alewives were gone. It was as if a switch had turned off; there was no more source of bait in that area for lobstermen.

On April 25 at 1:03 PM on a Thursday our class took salinity samples at the St. George marsh. At this time of day there was a normal tide so there was no flooding. We took a sample in the marsh in three different spots of the marsh. We took a sample right in front of the dam. Than we took a sample on a rock behind the parking lot, and our last sample we took was to the left of the south side of the marsh.

What we are concerned about is that there is salt in our marsh. The samples we took at that time show that there is 0.06ppt-0.27ppt. A couple days earlier we had some tides that were high enough to flood into the marsh which could leave some salt behind. Originally there was no salt ever in the marsh, but now that the climate is a lot hotter the tides are a lot bigger.

Our community has tried to stock the marsh from 2009-2013, but they had no luck bringing the alewives run back. Then the state noticed that the culvert was too shallow so they put a new culvert in, in 2015. Since then there have been a few alewives in the culvert.

The work we are doing for the marsh is to help the alewives. We want to know if the salt really is the problem in the marsh and if it is then how can we fix it.

We are hoping that our experiment will give us an answer to what’s happening in the marsh. The experiment is to see how the salt is affecting the different stages of alewives egg stage, newborn stage, and juvenile stage. If we can find out that the salt is the problem then we can find a way to solve it, whether it would be to put a higher dam so that salt water does not flood into the marsh or to find a way to keep the alewives in a non-salt water area. We are hoping to find an explanation as to why the alewives are not coming back.