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Findings

FROM THE FIELD

JUNE 2026 — VOLUME 9

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Gulf of Maine
Research Institute

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Note from the Editors

Each year, rapidly changing ecosystems connected to the Gulf of Maine bring new and increasingly complex challenges for coastal communities, natural systems, and the people who depend on them. The careful observers, researchers, and writers contributing to Volume 9 of *Findings from the Field* take on complex questions and test novel solutions to these challenges. In this volume, you will learn how debris patterns can help us understand the impacts of plastics on our beaches. You will take a close look at the effects of sea level rise and coastal flooding on both built and natural environments. Students working across a range of environments and locations will introduce you to efforts to restore balance to ecosystems disrupted by invasive plants and insects.

Together, this collection of projects shows us that the next generation of researchers and climate stewards is ready and willing to take on our region's most pressing and delicate issues. We hope you will find inspiration in their work and feel encouraged to join this collective effort to better understand and respond to human impacts on our environment. We are grateful to these young scientists for their courage, curiosity, and hard work as well as to the educators and community partners who support them.

Contributing Researchers, Writers, and Peer Reviewers from the following classrooms:

Amanda Ripa, Messalonskee Middle School, Oakland, ME
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Editorial Review by staff at the Gulf of Maine Research Institute and the Maine Department of Education.

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HWA in Milliken Mill Woods 2026

Kenny P, Mason V, Loranger Memorial School, Grade 7

Abstract

Our research question is: Does Milliken Mill Woods have enough live Hemlock Wooly Adelgid (HWA) to release predator beetles *Sasajiscymnus tsugae* (*St*) this spring? This research is important to scientists because we are helping to figure out how effective the predator beetles are at eating the HWA. We adapted the Gulf of Maine Research Institute's smear test protocol to collect data on the amount of HWA. We found live HWA on 70% of the trees we looked at (7/10 trees were infiltrated with live HWA).

Introduction

We are investigating Hemlock Wooly Adelgid (HWA) at Milliken Mill Woods in Old Orchard Beach, Maine during spring 2026. HWA is an insect that damages hemlock trees by sucking the sap out of the needles (GMRI HWA Species ID Card). The predator beetles, *Sasajiscymnus tsugae* (*St*), eat HWA (Tree Savers). They need live HWA to eat so they can survive and reproduce. Over the last three years, students have released 1,600 predator beetles in Milliken Mill Woods, and we want to see if HWA has increased or decreased.

This research is important to scientists because we are helping to figure out how effective the predator beetles are at eating the HWA. Scientists already know the predator beetles only eat HWA. Our research is important to the Conservation Commission because they purchase the beetles for us which costs $2.40 for each beetle since they buy in bulk. If they paid the whole price it would be $3 a beetle (Tree Savers). It's important to our class because students have been studying HWA since 2019. We will add more information to what scientists know because our data might show if the beetles are helping or not.

Our research question is: Does Milliken Mill Woods have enough live Hemlock Wooly Adelgid (HWA) to release predator beetles (*St*) this spring? We predicted that we would find enough live HWA for predator beetles again because there was a lot of HWA last year.

Methods

We collected data on March 9, 2026 in Milliken Mill Woods. This was our third year collecting data in these woods. We used the "HWA Predator Release Data Sheet" from the Gulf of Maine Research Institute. First, we checked if the tree is a hemlock by flipping the needles underside because hemlocks have 2 white racing stripes on the underside of the needles. Then we checked 10 branches and flipped them over to show the underside. Each branch we checked had to be at least 1 meter long and connected to the trunk. Every branch we checked, we wrote it down on the data sheet. If we found little white balls on the underside, which are HWA eggs, we would have to do the smear test.

The smear test is when you run your thumb over the little white balls to see if your thumb turns brown or there's white powder. White powder means the HWA is dead; brown means the HWA is alive. On the data sheet we would write alive, not alive, or not found for HWA on a branch. After 10 branches were counted, we would finally collect the health data on the tree. To know the tree was healthy, we checked if there were thick needles and if the tree had a thick canopy.

Results

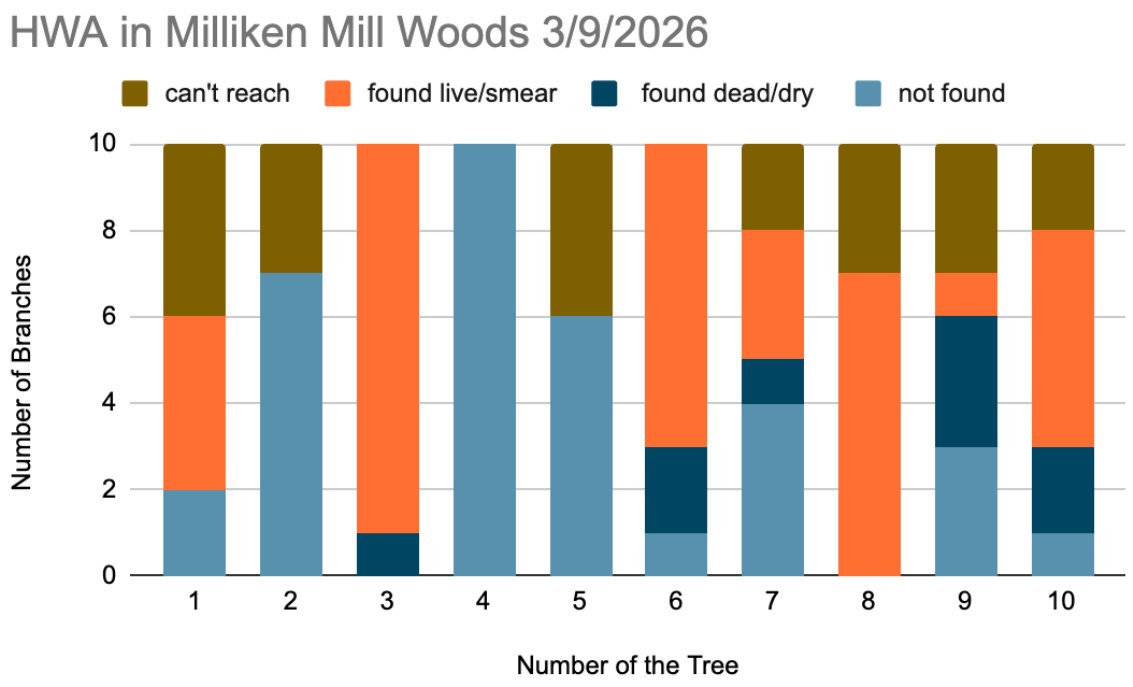


Figure 1: Graph of HWA on 10 trees in Milliken Mill Woods.

We collected data on March 9, 2026 in Milliken Mill Woods. Our data shows that 7 of 10 trees had live HWA, meaning that 70% of the trees we checked had HWA. Tree 4 is an outlier

because it didn't have any HWA on the 10 branches that we checked. The highest amount of live HWA that we found was 9 of 10 branches on tree 3.

Five trees had dead HWA on 1 to 3 branches. We know the HWA is dead because we did the smear test and there was no brown that came out.

Some factors might have affected our data such as we couldn't reach 2 to 4 branches on 7 trees. Another factor could be the cold winter which could have killed some HWA.

Conclusions and Discussion

We claim we found enough live HWA to release predator beetles in Milliken Mill Woods. Trees #1, 3, 6, 7, 8 and 10 had at least 3 branches (of 10) that had live HWA. We also checked for signs that the trees were healthy: new growth, thick canopy and cones. Trees #1 and 10 have live HWA and are healthy (thick needles, thick canopy), so those are the best to release the beetles.

Three trees didn't have any HWA on the branches we checked. One tree with no HWA had a thick canopy, which could mean the tree is healthy. Two trees without HWA had thin canopies, which could mean they aren't healthy enough for HWA. If the trees are too unhealthy, they won't be worth saving so we won't put beetles on them. Five trees had dead HWA. That could mean the predator beetles are killing the HWA or the HWA are dying from the cold. They don't have live HWA so we won't put beetles on them.

We only checked 10 trees, which is a very small portion of the forest. We can look next year to see if there is more or less HWA on the trees we treated. We can also check hemlock trees near them to get more data. Colleen Teerling (Maine Forest Service) wants to come with us next time we go to Milliken Mill Woods; she wants to see if we can find out if any of our old predator beetles are still alive. She would put a white sheet on the ground under the tree. Then we would hit the branches of the infected tree repeatedly and see if anything falls out. If we find predator beetles, that would mean they are surviving and eating HWA.

References

B, Miriam; T, Jacob; C, Marcus; and S, Lily. (2023). "Predator Beetles Will Be Released in Milliken Woods South," *Findings from the Field:* Vol. 6, Article 18.

Gulf of Maine Research Institute. (n.d.). Hemlock woolly adelgid species ID card [Fact sheet]. *Hemlock woolly adelgid species ID card*

Holden, Lillian, Cooper, Reagan, Kevin, Chloe. (2024). "Milliken Mills Woods has enough HWA for predator beetles to be released." Vol 7, reprinted in "Findings From the Field Articles: Hemlock Woolly Adelgid." Available at: https://citsci-beta-media.sfo2.cdn.digitaloceanspaces.com/media/documents/HWAFindings.pdf

Lifecycle of the Hemlock Woolly Adelgid [video]. (n.d.). The Tiny Terrors Citizen Science Project. Lifecycle of the Hemlock Woolly Adelgid

Loranger School HWA smear test video (2024): HWA_smear_test_video_3/2024.mov

Loranger Memorial School predator release planning walk with Colleen Teerling (2022). HWA Predator Beetles [Slideshow].

maine.gov. (n.d.). *HWA Detections in Maine's Forest Through 2023* [Map].

tree savers pa.com. (n.d.).[website] Tree Savers

Milliken Mills Trails. Maine by Foot. Available at https://mainebyfoot.com/milliken-mills-trails-old-orchard-beach/

Ash and EAB Around Our School 2025-2026

Wilson L, Andy N, Loranger Memorial School, Grade 7

Abstract

We are investigating how much Emerald Ash Borer (EAB) there was during 2025-2026 in ash trees around our school in Old Orchard Beach. This is important because EAB kills ash trees. We used the "Protecting Ash for the Future Data Sheet" from Gulf of Maine Research Institute to collect data on ash trees and signs of EAB. On March 4, 2026, we collected data on 11 ash trees: 2 white ash and 9 green ash. We claim that the two white ash have EAB because we saw D-shaped exit holes.

Introduction

We are investigating how much Emerald Ash Borer (EAB) there was during 2025-2026 in ash trees around our school in Old Orchard Beach. Ash trees can provide shade, homes for animals, and nutrients for the soil. The ash tree is also important to Wabanaki people because it's a part of their culture which includes basket making and stories with the ash.

We looked for green, white, and brown ash. They all have leaves with lots of leaflets. Attached to each leaflet is a tiny little stem called a petiole. White ash trees have leaflets attached by obvious petioles, turn red in the fall, and have diamond-shaped patterns on the bark (Maine Urban Tree Key and GMRI Fact Sheet). Green ash has 7-9 leaflets, very short petioles, and turns gold in the fall. Brown ash has no petioles, 7-11 leaflets, and irregular flakey bark that feels spongy.

Emerald Ash Borer is a beetle that lays eggs inside an ash tree. The eggs turn into larvae that eat the tree's insides. This is important because when the larvae eat the tree, they kill it (Maine Forest Service). Trees with EAB are also not good for basket making. Some signs of EAB are crown dieback, bark splitting, woodpecker feeding, and D-shaped holes. (Gulf of Maine Research Institute)

This research contributes to current research because we will send this data to GMRI so that other scientists can see what we found around our school. Also, if we find brown ash, we can report it so GMRI can tell basket weavers about it.

Methods

We collected data on ash trees 3 times in total. In fall, we went into Jameson Woods to look for ash trees. We looked for leaves with lots of leaflets and diamond patterns on the bark. We used a data sheet called "Ash Inventory Data Sheet" to identify the trees. We saw woven bark and gold leaves, so we identified them as green ash. We observed a little bark splitting, but no

holes or epicormic growth. We tested for spongy bark (brown ash) but we didn't find any. We found 4 green ash trees and tied yellow string around them so we could find them again.

On February 13, 2026, we went to an ash tree on the playground to practice collecting data. We saw opposite branching and diamond bark. It was not near water, so we identified it as a white ash. We also knew that the leaves were red in the fall. We saw bark splitting, woodpecker signs, and D-shaped holes. D-shaped holes are a definite sign of EAB because that's how the adults exit the tree.

On March 4th, 2026, we collected data on the green ash trees we had marked before in Jameson Woods. We also found more ash and identified them by opposite branching. After we identified an ash tree, we looked for signs of EAB like crown dieback, D-shaped holes, woodpecker damage, epicormic shoots, snake shaped galleries, and bark splitting. We estimated the tree's height by using a Tangent Height Gauge and a long measuring tape. We used a DBH tape to find the DBH (Diameter at Breast Height) of the tree. We recorded all the data on a paper worksheet, "Protecting Ash for the Future Data Sheet" from GMRI. It includes a section about the fieldsite. We noted if the trees were near water, near other ash trees, and growing in the woods or planted or not sure.

Results

Teacher: Mrs. Nye **Class:** Science GATES **School:** Loranger Memorial School, OOB

Ash Observation Data *measure DBH by dividing circumference of a tree 4.5 feet above the ground by Pi (3.14)

Ash tree characteristic data						EAB monitoring data					Field Site Information
Latitude	Longitude	Species (Brown = B, White = W, Green = G)	Diameter at Breast Height*	Estimated height (ft)	Sex (M/F/Poly)	Dieback (Y/N)	Bark Splitting (Y/N)	Woodpecker feeding (Y/N)	D-shaped holes (Y/N)	Epicormic Shoots (Y/N)	Planted (P), Natural (N) Unsure (U), Water flowing (WF), Water still (WS), No Water (NW), # of ash visible (XX); other notes
1) 43.51365	-70.39531	G or W	0.64	8.5	?	Winter	N	N	N	N	N WF 03
2) 43.51374	-70.395191	G	10.59	69	?	Winter	N	N	N	N	N WF 03
3) 43.51366	-70.394925	G	6.05	Not taken	?	Winter	Y	N	N	N	N WF 05
4) 43.51373	-70.394166	G	7.64	75	?	Winter	N	N	N	N	N WF 03
5) 43.51376	-70.395075	G or W	1.59	Not taken	?	Winter	Y	N	N	N	N WF 05
6) 43.51345	-70.395093	G	10.43	80	?	Winter	N	N	N	N	N WF 04
7) 43.51491	-70.395156	G	6.21	67	?	Winter	N	N	N	N	N WF ??
8) 43.51341	-70.39477	G or W	5.73/5.18	86	?	Winter	N	N	N	N	N WF 05 and 2 trunks
9) 43.51354	-70.395156	G	6.05	54.5	?	Winter	N	N	N	N	N WF ??
10) 43.5125	-70.393084	W	16.4	75	?	Winter	Y	Y	Y	?	U WF 40 ft away 2 trunks
11) 43.5125	-70.393178	W	8.2	42	?	Winter	Y	Y	Y	?	U WF 40 ft away same as 10

Figure 1: The table shows signs of EAB found on 11 ash trees near Loranger Memorial School on March 4, 2026.

We collected data on eleven ash trees in total near our school. Only two trees showed signs of EAB, which were bark splitting, woodpecker holes, and D-shaped holes. They were both white ash and were near the playground and either had two trunks and was the same tree or was two separate trees growing side by side.

We think the other nine trees were green ash. We know they're natural because they were grown in the forest. We identified them as green ash because we saw yellow leaves on six of them last fall. Tree number 3 and 5 showed a small amount of bark splitting. None of the others showed signs of EAB.

Conclusions and Discussion

We claim that the two white ash have EAB because we saw 3 of 5 signs: bark splitting, woodpecker feeding which shows that woodpeckers hunt for insects and larvae in the bark, and D-shaped holes which shows that EAB adults have exited the tree. We claim that the green ash is healthier because six had no signs of EAB, and two just had bark splitting, which could be from something besides EAB.

We think the green ash could be healthier because there are more trees around them, more biodiversity, and fewer people around them. Next year, we could look at more ash trees and check other people's data to see if they also found that green ash trees are healthier.

For trees #1, 5, and 8, we are not sure whether it is green or white ash because we didn't see the leaves, due to it being winter. However, we think they're green ash because they're growing in the same area as other green ash. Tree 1 is a baby ash and Tree 5 is young, so we think that ash trees nearby are producing seeds.

Our next steps are to look for flowers in spring and seeds in fall. If we find seeds, we will send them to the lab for inspection. We're doing this because if the ash trees ever go extinct, the lab could keep the seeds to replant them once we know all of the EAB is dead.

References

Emerald Ash Borer (EAB) Updates: Forest Health & Monitoring. Maine Forest Service. Available at https://www.maine.gov/dacf/mfs/forest_health/invasive_threats/eab/EABsigns.shtml

Gulf of Maine Research Institute. (n.d.). Ash species ID card [Fact sheet]. Fraxinus spp. Distinguishing Characteristics of White, Green, and Brown Ash.

Forest Trees of Maine: Centennial Edition. (2008). Maine Forest Service.

Maine Department of Agriculture, Conservation and Forestry. "Maine Urban Tree Key." Available at Project Canopy: https://www.maine.gov/dacf/mfs/policy_management/project_canopy/resources/index

Atlantic White Cedar grows worse in 6 ppt salt water than in tap water

Charlotte D, Isaac D, Loranger Memorial School, Grade 7

Abstract

We are investigating how Atlantic white cedar (AWC) resists salt water. This is important to investigate because sea levels are rising which can hurt AWC, a rare tree in Maine. To investigate, we grew AWC in our classroom and gave 10 of 20 seedlings 6 ppt salt water (7.2 grams of Instant Ocean per liter) and the others tap water. We found that more trees died in the salt group, 4 there and 1 in the control (although, the control that died arrived 1 week after the rest, making its data not reliable). Based on our data, the salt negatively affected the trees, causing them to grow slower and lose branches.

Introduction

We are investigating how Atlantic white cedar (AWC) resists salt water. It is important to know that sea levels are rising, and how to identify AWC. AWC has blue-green needles, small cones, and gray-brown, brittle bark. We are doing this because we found AWC in the Saco Heath, which connects to the Goosefare Brook, which runs to the sea. When the sea levels rise, it will make the Goosefare Brook saltier, and the salt may slowly move upriver into the Saco Heath. This is bad because it may cause AWC to die out due to the salt, and AWC is helpful for the ecosystem. For example, the Hessel's hairstreak butterfly lays its eggs on AWC trees and the larvae feed on new growth (mass.gov).

We are doing this study with Christopher Newport University (CNU) in Virginia. They are researching this because AWC is threatened by climate change in the USA and they are trying to save it. They invited students and teachers from 25 schools from Maine to Texas, to help them study AWC salt tolerance. Scientists already know that AWC grows between Maine and Mississippi on the east coast. The species is threatened because climate change causes sea level rising and global warming (Fowler, Christopher Newport University). Our investigation will give more information to the scientists because we live in the furthest north spot where AWC can grow, Maine. CNU assigned us to investigate the effects of 6 ppt salt water over 3 weeks. They assigned other levels (1, 3, 6 ppt) and durations (3 or 6 weeks) to other schools.

Our research question is: Does AWC grow better, or at least the same, in salt water? In total, we measured 7 times over 7 weeks. This was our second year doing this investigation with Christopher Newport University in Virginia. Based on last year, when all our seedlings survived, we predicted that AWC will grow normally.

Methods

We put each one of our four-year-old AWC seedlings in soil within a drainable pot, which we then put in a white non-draining pail to hold the water. We grew them indoors under a mostly red growlight, with blue and white in smaller quantities. We chose this setting because it was optimal for seedling stage plants. We watered them at least once a week, making sure the white pail was ⅓ of the way full. We watered them like this because AWC trees grow in areas with great amounts of water. The trees were placed near a window but were not specifically organized. Therefore, there is no measurable variable for the amount of sunlight because we transported the seedlings back and forth in no specific order when measuring.

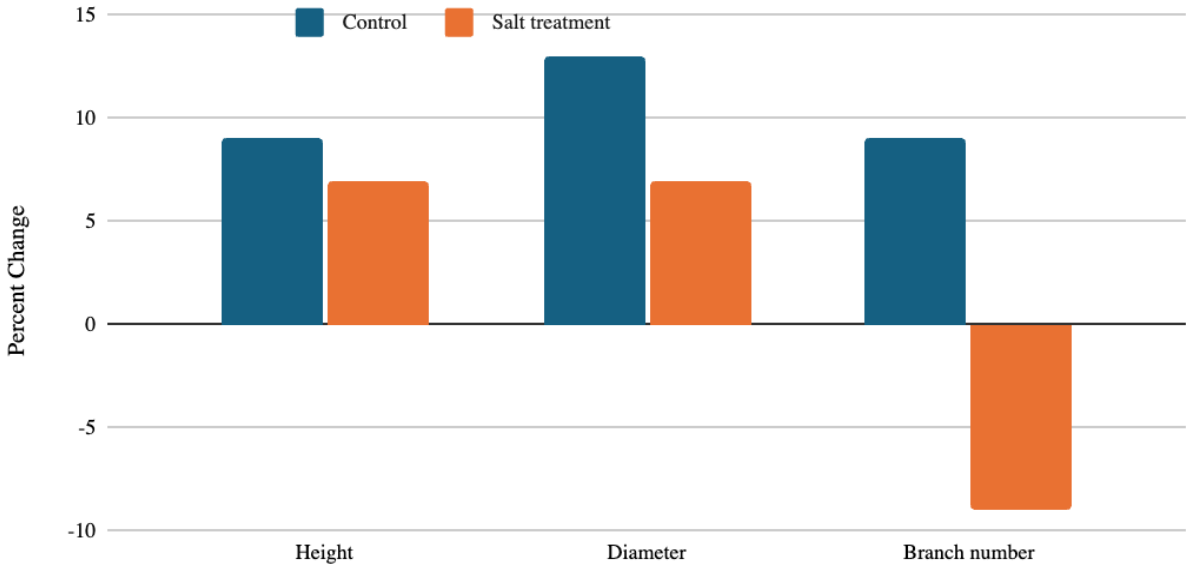
Three weeks later, we started to water trees 11-20 with 6 ppt salt water, using 7.2 g of Instant Ocean per liter, as instructed by CNU researchers. We watered trees 1-10 with fresh water as a no-salt control, We did this for 3 weeks, then flushed the salt treatment pots by pouring fresh water through them. We used a refractometer to make sure all the salt had been flushed out.

Each week, we collected data on each tree. We estimated percent brown by counting all branches that started from the trunk and were at least 2 cm long. We then counted how many of those branches were brown; if any part was green, it was considered a green branch. We then determined the percent brown by dividing the number of brown branches by the number of all branches on the tree. Percent brown tells us how healthy the tree was. If it was mostly green, it's a healthy tree. If it's mostly brown, it’s not a very healthy tree.

We measured height in centimeters with a ruler, measuring from a white line we drew at the base of the stem, to the end of the brown part of the stem. We also measured the diameter in millimeters, using a caliper around that previously mentioned white line. The white line improved the accuracy of our data because it formed a consistent point of measurement as the tree grows.

Results

Figure Showing Percent Change



The graph shows that the salt treatment trees had lower positive percent change in all three parameters: height, diameter and branch number. We were told by CNU to use percent change rather than the normal data.

Left: Control group. Mostly green. *Right: Treatment group. Mostly brown.*

The photos show our seedlings at the end of the investigation.The index cards show 0-10% brown on left, 10-25%, 25-50%, 50-75%, and 75-100% brown on right.

In the salt treatment group, 4 seedlings died: number 11, 16, 17 and 19. In the control group, tree #1 died, but it is an outlier because it arrived a week after the others and was dried out before we planted it.

Conclusions and Discussion

The graph shows that the seedlings are stressed by the 6 ppt salt. In the salt group, 4 trees ended up dying, while only 1 in the control group died. The graph shows that the salt-exposed trees grew slower in height and diameter. Percent change for branch number was negative because some branches fell off trees in the treatment group. The control group grew normally, as expected, except the one that came after the others.

All the trees got tiny flies and white bugs that might have affected their health. We could possibly try to identify the insects. We think the 4-year-old trees didn't have enough soil or space in the pot for their roots to grow, and that lack of space caused them to die. Last year all our seedlings survived, but those were only 1 year old, possibly being too small to run out of space in the pot.

Restoration of AWC in Maine should focus on areas that are unlikely to receive as much as 6 ppt salt. We could investigate further by comparing our results with other groups' results for saltiness (1, 3, or 6 ppt) and treatment duration (3 or 6 weeks) to see how vulnerable their seedlings were to salt intrusion. We could also test the saltiness of water in the Saco Heath. We tried to test it this year, but there was a drought and we didn't find any water near the AWC trees. We could also research other people's observations of the effects of salt water on other types of trees to see how vulnerable or resilient other species are compared to AWC.

References

Fowler, Charlotte. AWC 25-26 Introduction. (2025) Christopher Newport University. Available at https://docs.google.com/presentation/d/1qkJOU-O0wRPEAkb2N27RT9NE4FaDbTMb/edit?slide=id.p4#slide=id.p4

Berry, M. (n.d.). Saco Heath Preserve. The Nature Conservancy. Retrieved May 7, 2026, from https://www.nature.org/en-us/get-involved/how-to-help/places-we-protect/saco-heath-preserve/

Maine Forest Service. Atlantic White Cedar. Forest Trees of Maine. (2008). 52-53. Available at https://www.maine.gov/dacf/mfs/publications/handbooks_guides/forest_trees/pdf/atlantic_white_cedar.pdf

Maine Natural Areas Program. Chamaecyparis thyoides (L.) B.S.P. Atlantic White Cedar. Available at https://www.maine.gov/dacf/mnap/features/chathy.htm

MassWildlife's Natural Heritage & Endangered Species Program. Hessel's Hairstreak. Hessel's Hairstreak | Mass.gov

Distribution of Marine Debris in Maine's Ecosystems: A Three-Year Study of Micro and Macro-Plastics

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Keywords

Plastic, pollution, debris, environment, ecosystem

Overview

This study investigates macroplastics and microplastic quantities across three southern Maine coastal ecosystems to evaluate how human activity correlates with debris level. Results revealed that plastics were the primary pollutant, and microplastic rates increased in urban areas. These findings emphasize the need for practical interventions and community initiatives to address plastic pollution on a local and global scale.

Summary

Plastic pollution is an escalating crisis, posing risks to the environment and human health. In 1950, 2.3 million tons of plastic were produced; today, it exceeds 460 million tons. Microplastics have been located in the human brain, heart, liver, breast milk, and more. This study aimed to quantify the types and quantities of macroplastic (debris larger than 5mm) and microplastics (particles smaller than 5mm) in three southern Maine coastal ecosystems and investigate correlations between pollution levels and human activities. Three years of prior research have revolved around macroplastics, using the Marine Debris Tracker App to contribute data to a nationwide database. Plastic comprised 79.3% of collected debris. More recent research concentrates on microplastic data collection with updated protocols and sampling locations. Water samples measuring 500 mL were collected weekly at Back Cove in Portland, the Scarborough marsh, and Willard Beach in South Portland, representing diverse ecosystems: open ocean, intertidal marsh, and estuary. Samples were then filtered using vacuum filtration and quantified by four to eight team members under a compound microscope. Microplastic quantities averaged 30 and 43 particles for Back Cove Parking Lot and Right Side, respectively, 30 for Scarborough Marsh, and 19 for Willard Beach. For macroplastics, plastics constituted 57.3% of collected debris, followed by paper and lumber at 30.6%. These results supported previous hypotheses about urban areas having higher plastic concentrations. This study emphasizes the criticality of monitoring local ecosystems. Beyond research, our team led education-based presentations and upcycled marine debris into publicly displayed art, encouraging community-driven solutions.

Introduction

Since the 1950s, plastic pollution has skyrocketed, producing over 460 million tons annually. (1) Of this number, it is estimated that 33 billion pounds of plastic are deposited into the ocean annually, which is equivalent to about two garbage trucks' worth of plastic per minute (2). Plastic never decomposes, but breaks down into smaller pieces, called microplastics. These particles, under 5mm, pervade ecosystems and drinking water, and negatively affect animals and humans. Microplastics have been found in critical human organs, including the brain (3), heart (4), liver and kidney (5), breast milk (6), and more. Nihart et al. reported that human brains contain up to seven grams of microplastics–which is about the same weight as a plastic spoon. Researchers found this quantity increased by 50 percent between 2016 and 2024 (7).

Not only do microplastics percolate into human organs, but even the manufacturing of plastics is unsustainable, as it is primarily derived from fossil fuels (8), containing a myriad of toxic chemicals (9). These insidious chemicals travel up the food chain, from fish to human plates, where they are ingested. Ullah S et al. concluded that microplastics disrupt endocrine systems in mammals, manifesting hormonal abnormalities, toxic reproductive responses, and immune function deficiencies (10). Furthermore, Marfella et al. (2024) reported that microplastic presence in the heart's carotid plaque heightens the risk of stroke, heart attack, or even death by 4.5 times in a three-year time frame (11).

Globally, plastic is the most widespread kind of marine debris located in the ocean and Great Lakes (12). Matthew J. Heard (2024) reported that urbanization escalates plastic pollution levels due to recreation and tourism (13). Further research supporting urbanization as a key factor in microplastic content indicates heightened levels of microplastics in urban areas compared to rural locations, particularly near the outputs of storm sewers (14). Researchers of this study deduced that microplastic concentrations in rivers are significantly positively correlated with human presence, emphasizing factors such as population density, industrial and residential land usage, and heavy traffic areas. In contrast, they found forested locations to negatively correlate with microplastic abundance.

The Plastic Pollution Coalition reports that of all plastics produced, 40% are for single-use items (15). In addition to this, only 9% of all plastics are recycled (16). The proliferation of single-use plastics, combined with the low recycling rates, signifies the deficiency of current plastic disposal methods.

Microplastic research is still emerging, and there remains much to be discovered. Further research is needed on how plastic pollution affects local ecosystems and how community interventions suffice for plastic disposal. This study underscores this need, investigating plastic prevalence in three water ecosystems and analyzing how urbanization correlates with plastic quantities. We hypothesized that plastic rates, particularly microplastics, would increase in urban areas, compared to less populated sampling locations. The conclusions of this study demonstrate the proliferation of microplastics as they were identified in every water sample and more prevalent in urban areas.

Results

Macroplastics

Over three years of data collection (2022-2025), 10,506 pieces of marine debris were collected from Back Cove. Each piece of litter was geotagged using the Marine Debris Tracker App. Plastic constituted 73.6% of all debris collected, followed by paper and lumber (20.7%). Cloth, metal, and rubber were rare, all comprising less than 2% of total debris (Figure 1).

The majority of collected plastic debris was composed of smoking products (24.6%), food wrappers (22.7%), other food and beverage items (13.6%), and plastic fragments (13.4%), accounting for 74.3% of total plastic. The remaining 25.5% of plastic debris was composed of film, foam fragments, personal care products, and other miscellaneous items (Figure 2).

Microplastics

Microplastics were identified in every water sample across all three locations. Back Cove contained the highest averages for microplastic content, with 30 particles per 500 mL at Parking Lot and 43 particles per 500 mL for the ¼ mile Right location. Scarborough Marsh averaged 30 particles per 500 mL, whereas Willard Beach averaged 19 particles per 500 mL. (Figure 3).

Statistical analysis confirmed significant differences in microplastic concentrations among sites (Kruskal-Wallis $\chi^2 = 17.53$, df = 3, $p < 0.001$, **Figure 4**). Post hoc Dunn tests revealed that Back Cove Right Side contained significantly higher concentrations than Back Cove Parking Lot ($p = 0.045$), Scarborough Marsh ($p < 0.001$), and Willard Beach ($p = 0.046$), **Figure 4**. In contrast, no significant differences were found among Back Cove Parking Lot, Scarborough Marsh, and Willard Beach. These results, supported visually by the boxplot distributions, indicate that the Right Side of Back Cove is a localized hotspot for microplastic pollution, while the other sites exhibit similar, lower levels.

Discussion

The findings of this study reveal the consistent prevalence of plastic in the environment, particularly in urbanized areas. In agreement with global studies, plastic has the highest abundance of all marine debris. Plastic accounted for 73.6% of total marine debris. Of this percentage, food wrappers and smoking products were the most common, drawing attention to the over-reliance on single-use plastics. Beyond macroplastic collection, microplastic analysis has reinforced these findings, suggesting increased quantities of microplastic particles in urban areas, like Back Cove.

Each sampling location had an outlier, with microplastic quantities averaging more than 100. The outlier weeks occurred at different times of the year for each sampling location. It remains unknown what caused this drastic variation, but may be related to extreme weather events, sewer drainage irregularities, ship waste spillage, or other unknown events.

The Back Cove estuary is surrounded by multiple highly trafficked areas, including Hannaford Supermarket, Interstate 295, the Back Cove Trail, and Payson Park. There are few waste receptacles present in public areas around the Back Cove area, resulting in a lack of trash disposal methods for pedestrians, suggesting that the methods used to prevent plastic from entering the ecosystem are largely ineffective. This discarded debris enters the estuary and breaks down into microplastics over time. Back Cove, the most urban sampling location, contained the highest microplastics concentrations. More specifically, the Right Side is adjacent to a construction site, where heavy equipment and loads of building materials are circulating daily. A storm drain is situated between the two sites, possibly accounting for higher concentrations of microplastics in the estuary. Statistical analysis confirms that the Right Side contained significantly higher concentrations of microplastics than the remaining locations. Back Cove Parking Lot, Scarborough Marsh, and Willard Beach showed no significant differences in concentrations. Together, these results align with existing research, suggesting that urbanization and stormwater infrastructure drive elevated microplastic quantities, stressing the influence of land usage and waste runoff solutions on aquatic health.

This research not only aligns with globally collected data but also showcases the criticality of plastic pollution in southern Maine. Current pollution interventions appear to be insufficient for the level of marine debris present. The prevalence of single-use plastics, such as food wrappers, indicates the need for initiatives such as increased receptacles, public awareness campaigns, and changes in legislation. Results contribute to the growing body of data about urbanization heightening plastic debris quantities. Effective solutions to local pollution must include a combination of educational programs, policy change, and public awareness, i.e., through upcycling discarded debris into publicly displayed art. This will ultimately increase general knowledge about the urgency of plastic pollution and inform consumers about environmentally sustainable choices.

This study extends and broadens the current research on plastic pollution in local ecosystems in Maine by addressing gaps in current knowledge. Few studies have investigated the distributions of plastic across varied ecosystems and analyzed how rural and urban populations affect pollution rates. This research fills these gaps, making its findings particularly significant.

While this study highlights the pervasiveness of plastic in the local environment, limitations should be acknowledged. Our research team only had access to one macroplastic clean-up location, resulting in no control group to compare the macroplastic results against. In addition, macroplastics were primarily sampled during the spring because snow coverage limited winter accessibility, causing potential for seasonal variance. Furthermore, when quantifying microplastic particles, very small particles may have gone undetected by the microscope. Additionally, clear particles may have been present but not quantified due to invisibility. Despite these limitations, this research contributes to local data and global research and strengthens the need for educational and community-driven solutions.

Further research may include testing for season variation, as this study only explored macroplastic prevalence during the spring and fall. This would help gauge the stability of pollution rates and provide information about seasonal fluctuations. Additional microplastic

sampling sites should be explored for a greater comparison across diverse regions and population densities. Furthermore, the chemical composition of microplastics should be researched to determine the source of pollution and the primary industries responsible for plastic waste output. Techniques like Raman Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), and pyrolysis Gas Chromatography Mass Spectrometry are primarily utilized for identifying and analyzing microplastic compositions (17).

Materials and methods

Microplastic Collection and Analysis

Once a week, 500mL of surface water was collected at each sampling location (Back Cove, Willard Beach, and Scarborough Marsh) using glass storage bottles (Pyrex 500mL No. 1395). A team member entered the water until depth exceeded the depth of the sampling flask, then submerged the mouth of the sampling flask below the surface of the water, avoiding areas with high turbidity. Water samples were filtered through a vacuum filtration system (Stoney lab 1000mL Vacuum Filtration Kit), and microplastics were captured on 0.45 µm gridded membrane filter paper (Millipore MCE). Filter papers were transferred into glass petri dishes (Stoney Lab 60 mm) using high precision forceps (Carolina Biological). Three team members quantified microplastics using a compound microscope (Omano 400x Compound Microscope) and took an average of microplastics per sample. Data was recorded weekly in a Google spreadsheet. An average of 21 samples was collected at each location in eight months.

Macroplastic Collection and Analysis

Macroplastics were collected during organized beach cleanups (10-30 participants) at one primary location (Back Cove). Participants were grouped into teams of 4-10 people. Each group used at least one five-gallon bucket and a smartphone installed with the Marine Debris Tracker (MDT) app. Participants wore nitrile gloves (Med Pride) while collecting marine debris, as they moved across the high tide line, geotagging debris using MDT. Later, all participants were regrouped and marine debris was compiled, sorted, and disposed of in proper receptacles. Debris selected for art projects was washed with water and dish soap prior to fabrication.

Acknowledgments

The author would like to acknowledge the Baxter Plastic Team, who assisted with waste cleanups, data collection, upcycling, and community presentations. Over three years, this group has included: Jenna Andrews, Hayden Daisey, Carlos Fra-Nero, Jack Forsyth, Hunter Gibson, Sean Glass, Zachary Hall, Teddy Kelley, Martessa Vine, Monique Venerable, Eliot Verry-Gardella, Elijah Whitehead, Julietta Vazquez, Wyatt Worcester, and Youssouf Youssouf. In addition, the author acknowledges the Blue Ocean Society, for their microplastic protocol, which the author and researchers later refined to Tracy Ostrom's microplastic procedure. Upon first starting, this project received funding from the Gulf of Maine Research Institute.

References

(1) International Union for Conservation of Nature (IUCN). "Plastic Pollution." *IUCN*, 2024. https://www.iucn.org/resources/issues-brief/plastic-pollution

(2) Oceana. "Plastic Pollution." *Oceana USA*. https://usa.oceana.org/our-campaigns/plastic/

(3) Amato-Lourenço, L. F., et al. "Microplastics in the Olfactory Bulb of the Human Brain." *JAMA Network Open*, vol. 7, no. 9, 2024, e2440018. https://doi.org/10.1001/jamanetworkopen.2024.40018

(4) American Chemical Society. "Microplastics Found in Human Heart Tissues, Both Before and After Surgical Procedures." *PressPacs*, 9 Aug. 2023. https://www.acs.org/pressroom/presspacs/2023/august/microplastics-found-in-human-heart-tissues-before-and-after-surgical-procedures.htmL

(5) Horvatits, T., et al. "Microplastics Detected in Cirrhotic Liver Tissue." *EBioMedicine*, vol. 82, 2022, 104147. https://doi.org/10.1016/j.ebiom.2022.104147

(6) Ragusa, A., et al. "Raman Microspectroscopy Detection and Characterisation of Microplastics in Human Breastmilk." *Polymers*, vol. 14, no. 13, 2022, 2700. https://doi.org/10.3390/polym14132700

(7) Nihart, A. J., et al. "Bioaccumulation of Microplastics in Decedent Human Brains." *Nature Medicine*, vol. 31, 2025, pp. 1114–1119. https://doi.org/10.1038/s41591-024-03453-1

(8) Center for International Environmental Law (CIEL). "Plastic & Climate: The Hidden Costs of a Plastic Planet." *CIEL*, 3 May 2019. https://www.ciel.org/reports/plastic-health-the-hidden-costs-of-a-plastic-planet-may-2019/

(9) United Nations Environment Programme (UNEP). "Chemicals in Plastics: A Technical Report." *UNEP*, 3 May 2023. https://www.unep.org/resources/report/chemicals-plastics-technical-report

(10) Ullah, S. "A Review of the Endocrine Disrupting Effects of Micro and Nanoplastics." *Environmental Toxicology and Pharmacology*, vol. 90, 2023, 103814. https://doi.org/10.1016/j.etap.2023.103814

(11) Marfella, R., et al. "Microplastics and Nanoplastics in Atheromas and Cardiovascular Events." *The New England Journal of Medicine*, vol. 390, no. 10, 2024, pp. 900–910. https://doi.org/10.1056/NEJMoa2309822

(12) National Centers for Environmental Information (NOAA NCEI). "Tracking Global Marine Microplastics." *NOAA NCEI*, 17 Aug. 2022. https://www.ncei.noaa.gov/news/tracking-global-marine-microplastics

(13) Heard, M. J. "Assessing the Relationship between Urbanization and Plastic Litter Pollution on California Beaches." *Regional Studies in Marine Science*, vol. 77, 2024, 103603. https://doi.org/10.1016/j.rsma.2024.103603

(14) Kunz, A., Schneider, F., Anthony, N., and Lin, H. "Microplastics in Rivers along an Urban–Rural Gradient in an Urban Agglomeration: Correlation with Land Use, Potential Sources and Pathways." *Environmental Pollution*, vol. 321, 2023, 121096. https://doi.org/10.1016/j.envpol.2023.121096

(15) Plastic Pollution Coalition. "Single-Use Plastics Health Impacts." *Plastic Pollution Coalition*. https://www.plasticpollutioncoalition.org/guides/singleuseplastics/healthimpacts

(16) Organisation for Economic Co-operation and Development (OECD). "Plastic Pollution Is Growing Relentlessly as Waste Management and Recycling Fall Short." *OECD*, 22 Feb. 2022. https://www.oecd.org/en/about/news/press-releases/2022/02/plastic-pollution-is-growing-relentlessly-as-waste-management-and-recycling-fall-short.htmL

(17) Sharma, P., Sharma, P., and Abhishek, A. "Sampling, Separation, and Characterization Methodology for Quantification of Microplastic from the Environment." *Journal of Hazardous Advances*, 2024. https://doi.org/10.1016/j.hazadv.2024.100416

Figures and Figure Titles/Captions

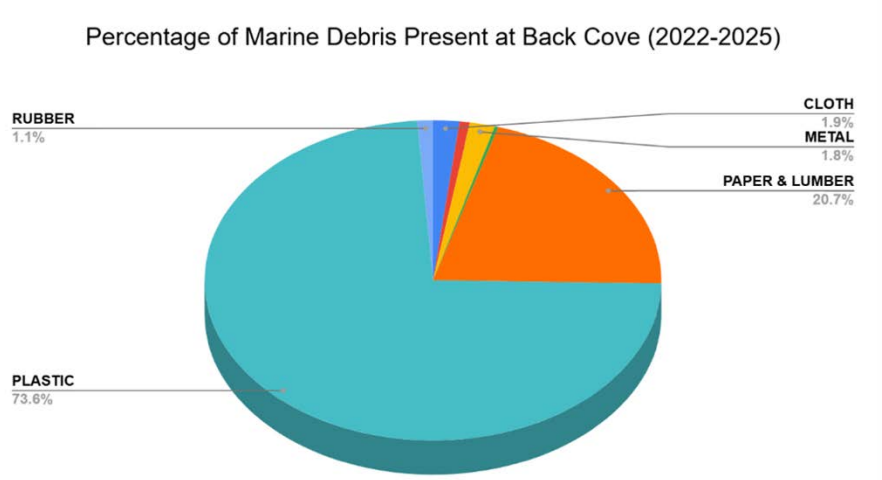


Figure 1. Percentage of Marine Debris Present at Back Cove (2022-2025).

Pie chart depicting relative percentages of macroplastics at Back Cove, Portland, ME over three years (2022-2025). Plastic accounted for 73.6% of debris, followed by paper and lumber at 20.7%, cloth (1.9%), metal (1.8%), and rubber (1.1%). Data were collected during annual cleanups conducted from 2022 to 2025 (n=3).

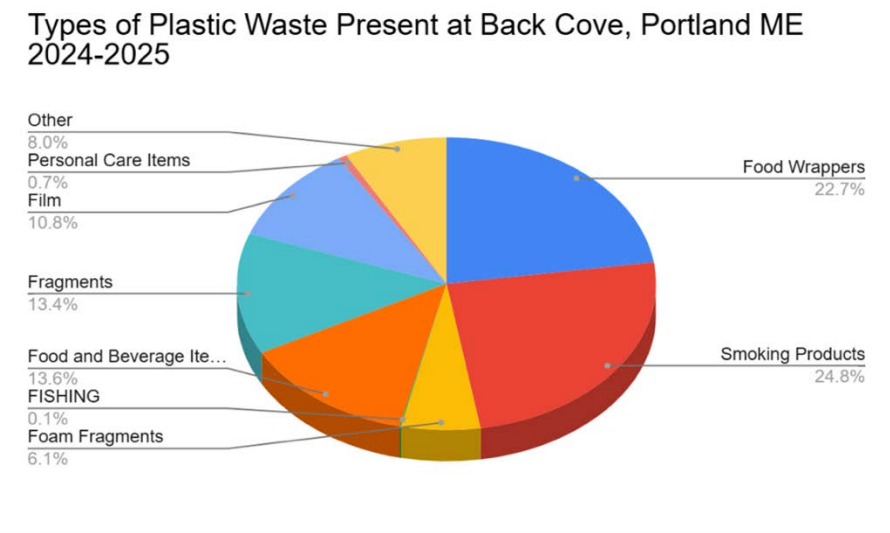


Figure 2: Pie chart showcasing the kinds of plastic waste present at Back Cove, Portland, ME. Smoking products account for 24.8% of plastic waste, while food wrappers comprise 22.7%, followed by fragments (13.4%), film (10.8%), other miscellaneous items (8%), foam fragments (6.1%), and personal care items (0.7%).

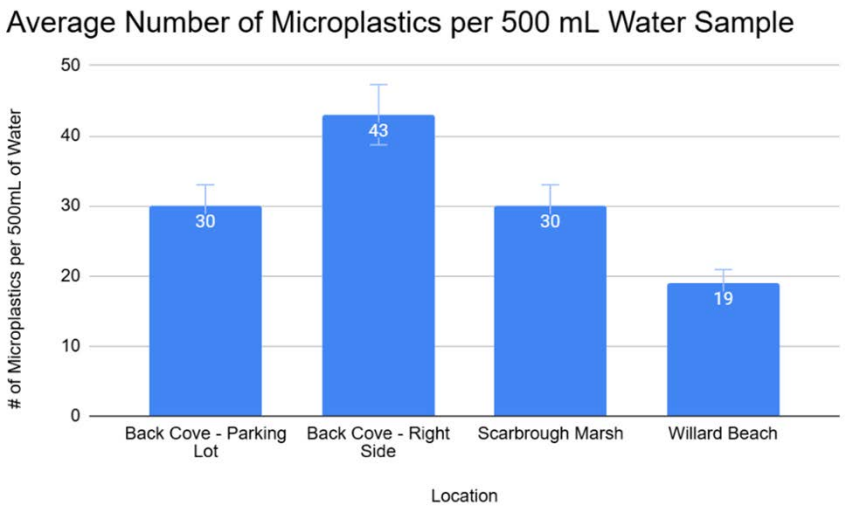


Figure 3: Average Number of Microplastics per 500 mL Water Sample

Histogram of average number of microplastics per 500 mL at Back Cove, Parking Lot and Right Side, Scarborough Marsh, and Willard Beach. Back Cove Parking Lot averaged 30 particles per 500 mL, while Right Side averaged 43. Scarborough Marsh and Willard beach averaged 30 and 19 respectively, per 500 mL sample.

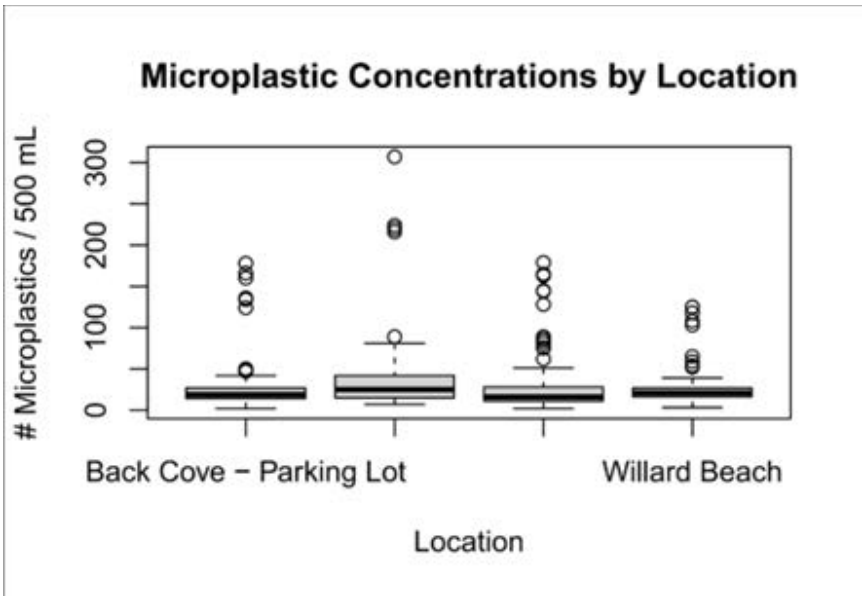


Figure 4: Microplastic Concentrations by Location

Boxplot of microplastic concentrations (particles per 500 mL) at Back Cove, Scarborough Marsh, and Willard Beach. Boxes show interquartile ranges, horizontal lines mark medians, whiskers extend to 1.5× IQR, and circles represent outliers. Locations from right to left: Back Cove Parking Lot, Back Cove Right Side, Scarborough Marsh, Willard Beach.

How Proximity to Humans Affect the Amount and Types of Plastics on Beaches

Lucy G., Blue Hill Consolidated School, Grade 6

Introduction

Plastic has many great uses. Plus, it's cheap to make and purchase. The problem is, half of the plastics produced are only for one use, then they are disposed of. Some plastics that are reusable get thrown away as well, and a lot of these unwanted plastics end up in our oceans. About 8 million tons every year!

(https://www.natgeokids.com/ie/kids-club/cool-kids/general-kids-club/plastic-pollution/) Over 500 trillion pieces of plastic are estimated to be floating in the sea, (https://education.nationalgeographic.org/resource/ocean-trash-525-trillion-pieces-and-counting-big-questions-remain/3rd-grade/) but what about the plastics that wash up on beaches? This got me thinking about how proximity to humans affects the amount and types of plastics on beaches. I was also interested in the chemical composition of the plastics at both beaches. I predicted that the beach with a closer proximity to humans would have a larger amount of plastic. I also anticipated that it would have a greater variety of plastics. To find out if my prediction was correct, I went to two local beaches, one with houses, moorings, and a restaurant, and another without.

Methods

On July 22 and 29 I visited two beaches, one near humans and one away from humans. Curtis Cove beach is farther from human activity, and is used mostly for swimming in the summer. Carrying Place beach is close to many houses, moorings, cars, and even a restaurant. I sampled fifty, 1- meter squared quadrats along a 100-m transect at each beach. This method is useful because it provides a consistent, systematic way to compare the amount of plastic at each beach. In the samples I collected both macroplastics, which are larger than 5 millimeters, and microplastics, which are smaller than 5 millimeters. I then analyzed the samples of plastic with an FTIR machine (Fourier Transform Infrared Spectrophotometer) at the Shaw Institute, a non-profit scientific research organization in Blue Hill, Maine. An FTIR shines infrared light on a piece of plastic. The way the plastic absorbs the light gives us clues about the chemical composition of the plastic. The FTIR gives us a light fingerprint, which is actually a graph, and the peaks in the graph tell us what bonds and atoms are in the plastic. The three most common types of plastic are polyethylene, found in plastic bags and bottles; polypropylene, found in textiles, packaging, and car parts; and polystyrene, found in packaging, insulation, food service, cups, trays, and fishing buoys. Every type of plastic has its own unique graph, so you can tell by the height, width, and bumps of the peaks what kind of plastic it is.

Figure 1: Curtis Cove Beach

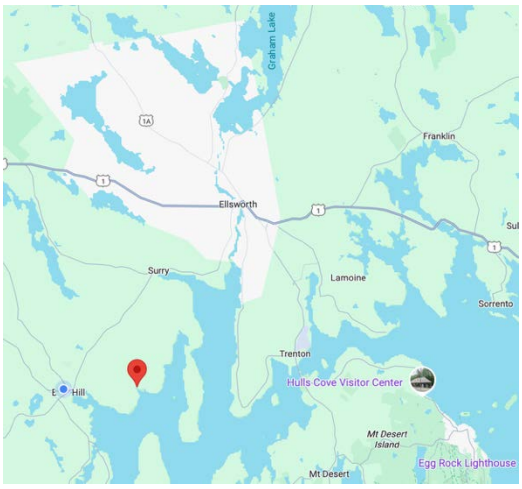


Figure 2: Red pin marks Curtis Cove Beach

Figure 3: Carrying Place Beach

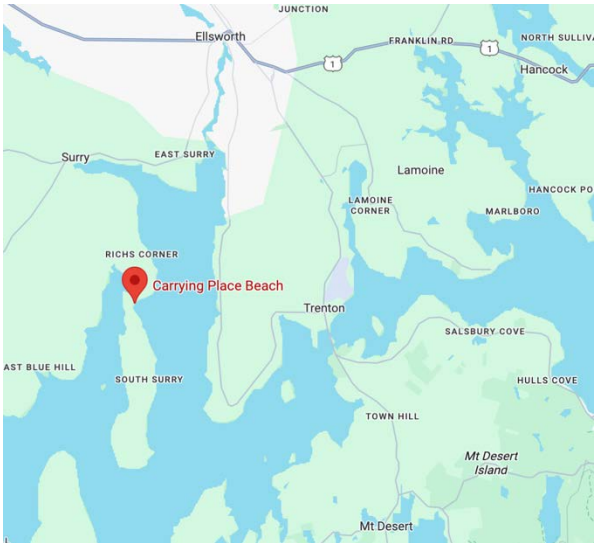


Figure 4: Red pin marks Carrying Place Beach

Figure 5: 1 meter squared quadrat at the wrackline of Curtis Cove

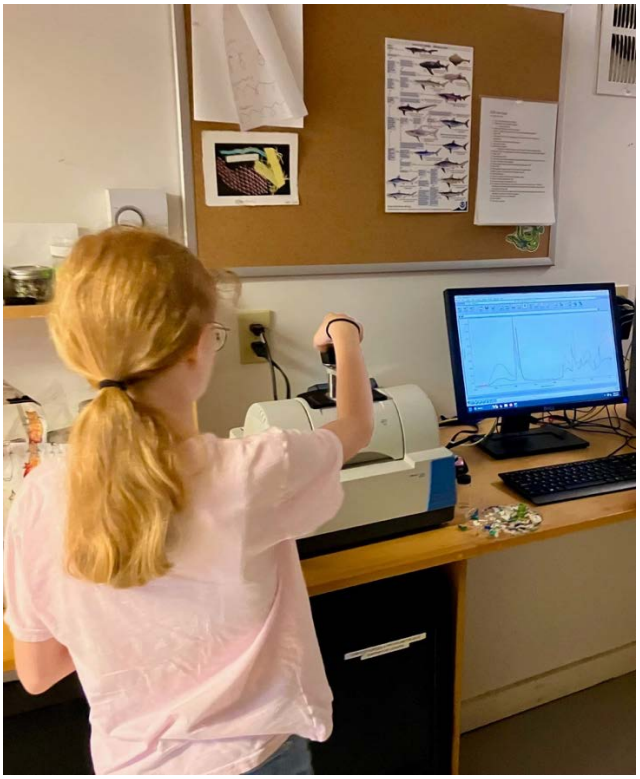
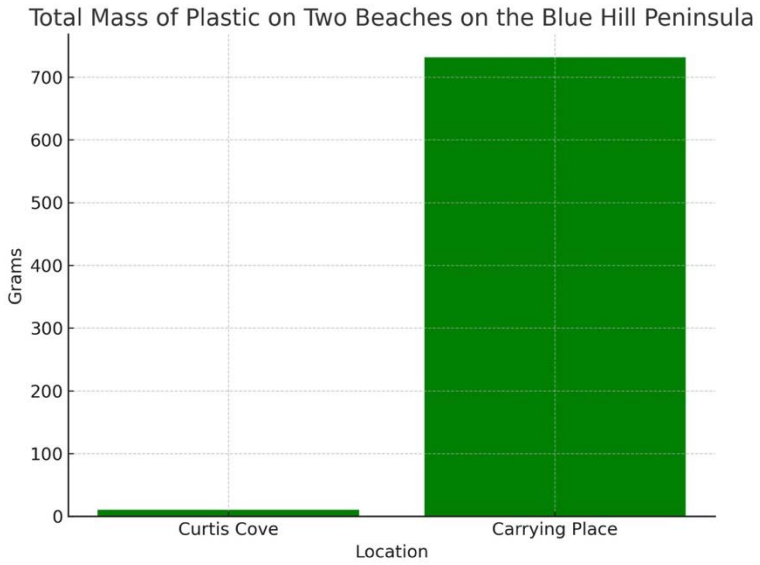


Figure 6: Putting plastic in the FTIR next to computer with the plastic graph

Results

At Curtis Cove (farther from humans) 32% of the plots contained plastic, while at Carrying Place (closer to humans) only 28% of the plots contained plastic. Curtis Cove quadrats contained a total of 10.236 g of plastic whereas Carrying Place quadrats contained a total of 731.628 g. There were 21 individual pieces of plastic collected at Curtis Cove and 22 pieces at Carrying Place, however, the pieces at Carrying Place were much larger than those found at Curtis Cove. Most of the plastic found at Curtis Cove was small bits of line or rope and some packaging. At Carrying Place, many of the samples were larger, brittle pieces of plastic that appeared to be from everyday products and household items including cat litter containers and decorative, artificial plants.



Types of Plastic at Curtis Cove (farther from humans)	Number of Pieces
PBT	2
Polyethylene	2
Polypropylene	13
Polyglycine	1
Polystyrene	2
Cellulose	1
Total	21

Types of Plastic at Carrying Place (closer to humans)	Number of Pieces
Polyvinylmethylether	4
Betacyclodextrin/epichlorohydrin colpolymer	2
Polyvinylacetate (PVC)	3
Polypropylene	1
Polyacrylonitrile co-butadiene	1
Polycaprolactone diol	2
Polyethylene	5
Nylon	1
Poly (3,3 diaminobenzophenon co 3,3,4,4, benzophenonetetracarboxylic dianhydride)	2
Poly (1,4-cyclohexanedimethylene succinate)	1
Total	22

Discussion and Conclusion

My hypothesis was correct. Carrying Place beach had a greater mass and a bigger variety of plastics. I noticed that Carrying Place had generally larger fragments than Curtis Cove, but in the end, the amount of fragments found for each beach was very similar. Curtis Cove had mostly polypropylene, while Carrying Place had a variety of plastics. Curtis Cove has a lot of lightweight consumer plastics, which suggests that the plastic is probably coming from beach visitors and fishing or boating activity, due to human use. Polypropylene and polyethylene are plastics that float, so they're common on beaches like Curtis Cove. Carrying Place, however, has plastics sourced from more industrial products, such as paints and glues, nylon clothing fibers, construction materials, coatings, and sealants. This tells us that Carrying Place is likely affected by runoff from roads or buildings, wastewater or stormdrains, and the breakdown of larger manufactured products into microplastics. This information means that different plastics are found on different beaches depending on what's surrounding them. Curtis Cove is used more by humans, so it collects mostly consumer and recreational plastics. Carrying Place has more industrial, construction and synthetic materials. From this experiment I learned that not all plastic pollution is the same, and you need to understand where the plastic is coming from. Carrying Place beach has a longer, wider shore, so I wonder if the tidal input and output had something to do with the amount of plastic it collected. All in all, the two beaches had a similar amount of plastic, while Carrying Place had greater mass. Curtis Cove had mostly polyethylene, or more recreational plastics, and Carrying Place had a variety of types, or industrial materials.

References Cited

Hawaii GK-12 Program. (n.d.). *Measuring abundance: Transects and quadrats* [Classroom lesson PDF]. University of Hawai'i. https://www.hawaii.edu/gk-12/opihi/classroom/measuring.pdf

U.S. Environmental Protection Agency. (2021). *Microplastic beach protocol: A community science protocol for sampling microplastic pollution* [PDF]. https://www.epa.gov/system/files/documents/2021-09/microplastic-beach-protocol_sept-2021.pdf

Ocean trash: 5.25 trillion pieces and counting, but big questions remain. (n.d.). https://education.nationalgeographic.org/resource/ocean-trash-525-trillion-pieces-and-counting-big-questions-remain/3rd-grade/

Chandler, G., & Chandler, G. (2022, August 9). *The problem with plastic pollution*. National Geographic Kids. https://www.natgeokids.com/ie/kids-club/cool-kids/general-kids-club/plastic-pollution/

The Comparison between Knotted Wrack and Bladder Wrack at Odiorne Point State Park during Low Tide and High Tide

Amelia P, Lincoln Akerman School, Grade 8

Introduction

The rocky shore intertidal zones are a very important ecosystem for many different types of animals, and specifically many types of seaweeds. "The intertidal zone is an important source of primary production and conduit for energy, nutrients, and pollutants between terrestrial and marine environments." (National Park Service, 2016) Seaweeds are not only a living organism that needs to be protected, but also many of them are the ones that are protecting others. "Seaweed provides food and habitat for other marine species, cleans coastal waters by removing excess nutrients from runoff, and absorbs carbon dioxide from the water which protects shelled animals (like oysters) from ocean acidification" (Aquarium of the Pacific, 2021) While we were at Odiorne Point State Park in Rye, New Hampshire, I realized just how much seaweed there was, and how much of it's is protecting its fellow organisms. So this study will focus on the question; Which species are overall more common, knotted wrack or bladder wrack?

To try to answer this question, the 7th and 8th grader students at Lincoln Akerman School in Hampton Falls, New Hampshire went to Odiorne Point State Park in Rye, New Hampshire on April 4th, 2025 to observe the different types of seaweeds and organisms that live there. This study builds onto the ongoing research on why there are more different types of seaweeds in the tide zones and why that is. "In the 1970s, Kelp and Irish moss accounted for nearly 80 percent of the seaweed cover on the seafloor off southern Maine, an area now dominated by low, scrubby, invasive seaweeds that account for more than 80 percent of the coverage, researchers at the University of New Hampshire have found." (Colin Woodard, 2019) My paper builds and contributes to the understanding of the ongoing changes in seaweed populations over time.

Methods

This study was conducted on April 4th, 2025 at Odiorne Point State Park in Rye, New Hampshire. The 7th and 8th grade students from Lincoln Akerman School collected data in both high and low tide zones on their scientific field trip. In order to reduce impact, sampling was done at two locations at the park: first at 43.043920, -70.711907, and the other at 43.041803, -70.712907. The times that the low tide zone testing was at 9:35 am and 10:30am, and the high tide zone testing was at 9:10am and 11:10am. Low tide was at 11:05 am that day, and 0.3 ft below sea level (US Harbors, 2025).

There were ten sample groups in the high tide zone and ten in the low tide zone. There were two sampling locations in order to sample a large area of the intertidal zone as well as reduce human impact of lots of people in one area. Each sampling group was made of three to four people and each person had a job and specific guide lines to follow to ensure they were fulfilling their jobs responsibilities. These were; data experts in charge of tallying numbers of organisms, photographers in charge of documenting the species found, and finally biologists who were experts on handling and identifying all that was being observed.

Right before each group was sent out to begin collecting data, they had to go over to their science teacher Mrs. Lapointe who had her phone and randomly generated a number for each group. In the area where all of the students were at Odiorne Point State Park, there was a transect, and once each group got their number, they found that number on the transect. After they found their number, the group proceeded to put their quadrats down and put it together right on top of their randomly chosen number. As everyone got to work doing the jobs that were assigned to them, they collected the data found from their quadrats and tally marked what they found on a datasheet. While the organisms were being observed and recorded, the biologists put all found organisms in a small bucket without harming them. The primary part of the data experts job was to find the percent cover of their groups quadrat, and in all of the graphs below you can see all of the percent coverage after it had been all combined together afterwards. Data experts prepared to collect data on percent coverage by practicing at school on vegetation in the school yard. Also, data experts had to pass a test to show they could properly identify intertidal species. Students also had multiple days of lab prep on identifying all organisms. Everyone's percent cover was different depending on where they were, but most groups' percent cover was mainly on knotted and bladder wrack. This was because there were so much of these two types of seaweeds at Odiorne Point State Park. That is what I found quite interesting while we were doing our research, and that is where this research started.

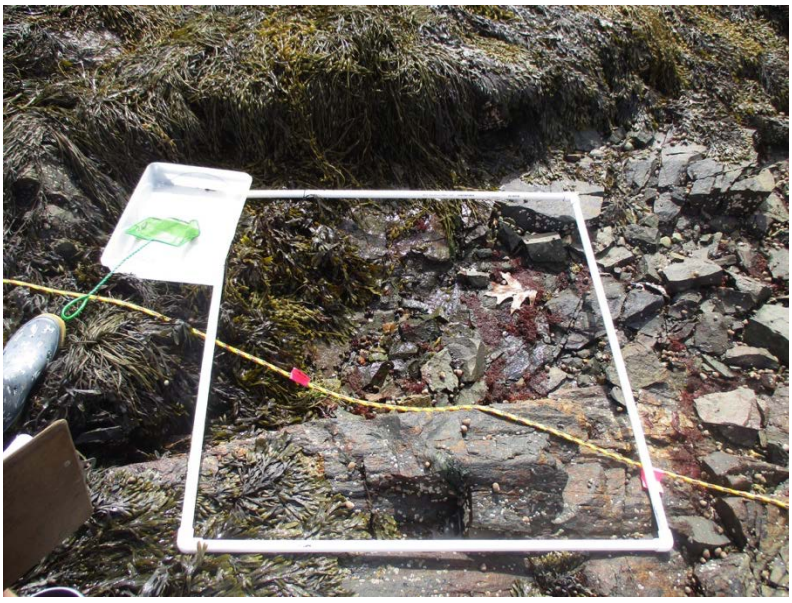


Figure 1: This photo shows the 1m by 1m quadrat where some students from Lincoln Akerman School studied the organisms in this space and then collected the data due to what they found and observed on April 4, 2025 at Odiorne Point State Park in Rye, New Hampshire.

Figure 2: This image shows the whole of Odiorne Point State Park in Rye, New Hampshire, and the edges of the water of the Gulf Of Maine that connects right off the park. (Seacoast Science Center)

Results

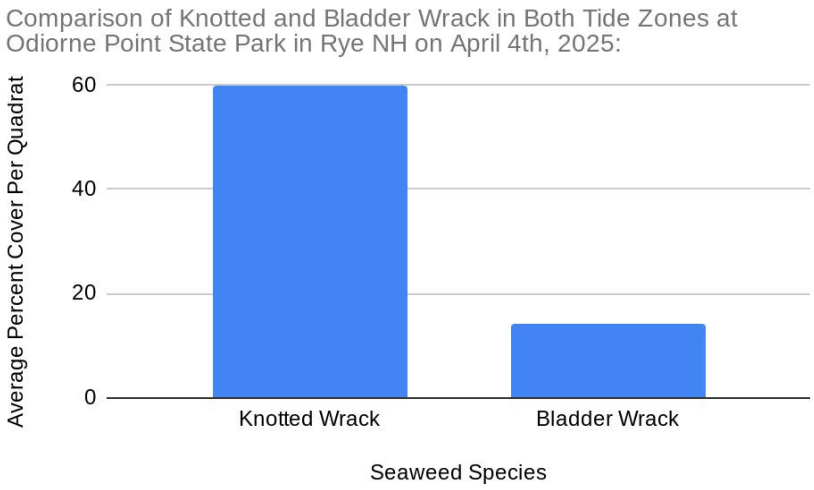


Figure 3: This graph shows that at Odiorne Point State Park in Rye, New Hampshire on April 4th, 2025 in high and low tide zones, there were more knotted wrack than bladder wrack on average percent cover per quadrat where the 7th and 8th graders at Lincoln Akerman School observed. When you look at the knotted wrack side you can see that knotted wracks average percent cover is 60, while bladder wracks are a bit less than 20 percent cover. Meaning that at Odiorne Point State Park knotted wrack may grow in larger groups, as well as it could reproduce more at one time.

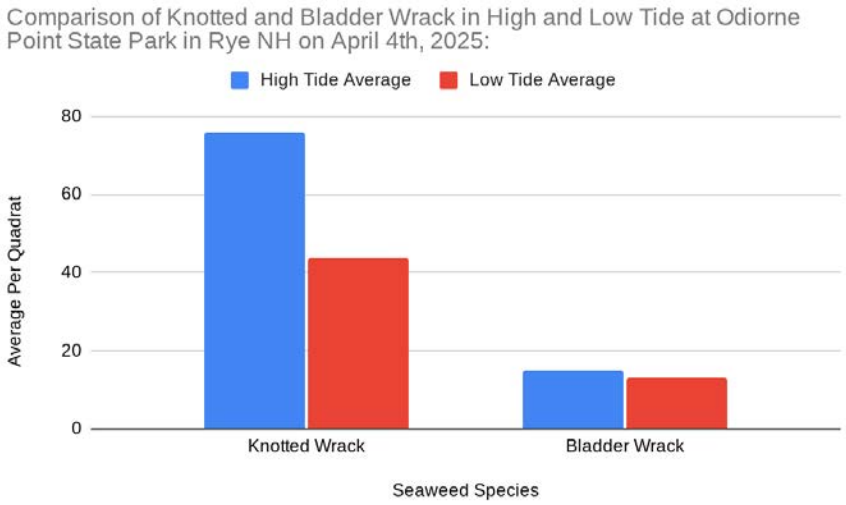


Figure 4: This graph shows that at Odiorne Point State Park in Rye, New Hampshire on April 4th, 2025 there are more knotted wrack in both high and low tide zones on average per quadrat where the students at Lincoln Akerman School collected data from. In high tide, the population of knotted wrack compared to bladder wrack is extreme. The high tide for knotted wrack is a bit less than 80 percent cover, while high tide for bladder is a little bit more than 40 percent cover. Then when we look at the low tide, knotted wrack population it's still much larger than bladder wrack, but it is a smaller difference from the high tide zone.

Discussion and Conclusion

At Odiorne Point State Park in Rye, New Hampshire, on April 4th, 2025 there is more knotted wrack in both tide zones, and more of it than bladder wrack overall. In you look up at Figure #4, you can easily see that in the high tide zone there is an extreme difference between the number of knotted wrack and bladder wrack. There is obviously more knotted wrack. Then while still looking in that same figure and graph you can see that for the low tide zone, although there are fewer seaweed numbers, knotted wrack still has more than bladder. The knotted wrack average for high tide is at least 75 percent coverage average per quadrat, the low tide average is just a little more than 40 percent coverage average per quadrat. Then if you look over to the bladder wrack side, the high tide is at least more than 15 percent coverage average per quadrant, while for low tide it's maybe 15 percent coverage average per quadrant. Because when seaweed is exposed to air for too long it dries up, so you would think that it would be less likely to thrive and be healthy in high tide, but it's more. "Dehydration-tolerant species inhabiting the upper tide zone may lose 90 percent of their cellular water when exposed to air during a low tide." (Sara Noland) When it's high tide more of the oceans water gets brought into areas just like Odiorne Point State Park, seaweed is brought in and then it stays. "It washes in with the high tide and lingers long after the waters recede." (U.S National Science Foundation, 2012)

One thing to keep in mind is that all of this data was collected by middle school students, none of us are professional sciences yet. I say this because there is a chance that there were some errors that were made along the way in this study. While we were at Odiorne Point State Park and observing all of the organisms and writing down what we found, there is a very low chance that it's all correct, to be honest, it's nearly impossible for it all to be spot on. For example, for all of the percent coverage, we didn't have tools with us to calculate the exact percentage that something covered in our quarats, we all just used our best educated guess. Also, we only went one day. We collected all of this information in the span of an hour for one cold day in April. Although it was impossible for us to get everything exactly right on this trip, future scientists can do things to get more accurate answers. For example, if the goal is to try to find out what types of seaweed species are more commonly found in different tide zones, like what mine was, then you would most likely have to go in different times of the year to see what changes are made based on the temperature on land and in the water. "Seaweeds provide food and shelter for coastal species. However, not all seaweeds are alike. For example, some prefer warm, tropical waters and others like it a little cooler and live in more temperate waters." (Victoria Treadaway, 2018) Not only do we need to protect all of these different types of seaweeds, but we also need to learn more about what they like and why they like it if we really want to understand these amazing creatures.

Works Cited

US Harbors | US Harbors Tide Charts, Marine Weather, Harbor Guides 1,400 Harbors - US Harbors, https://www.usharbors.com/. Accessed 19 May 2026.

"All Washed Up and Somewhere to Go | NSF." National Science Foundation, 20 July 2012, https://www.nsf.gov/news/all-washed-somewhere-go. Accessed 23 April 2025.

"Drivers of Change in Intertidal Communities." National Park Services, https://home.nps.gov/articles/intertidalchange.htm.

Noland, Sara, et al. "Tide Pool Seaweed." Salish Magazine, 18 June 2019, https://salishmagazine.org/tidepool-seaweed/. Accessed 23 April 2025.

"Seaweed | Seafood for the Future." Aquarium of the Pacific, https://www.aquariumofpacific.org/seafoodfuture/seaweed. Accessed 23 April 2025.

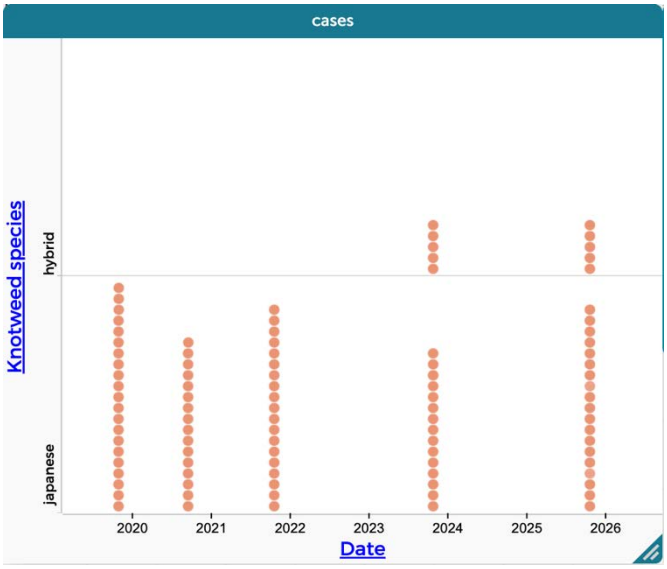
Treadaway, Victoria. "Seaweed may be a winner in a warming world." Oceanbits. Accessed 4 May 2018.

Woodard, Colin. "Kelp, the forests of the sea, vanishing from southern Maine as Gulf warms." Portland Press Herald, 16 November 2019.

Can psyillds solve our knotweed problem?

Hannah C, Messalonskee Middle School, Grade 7

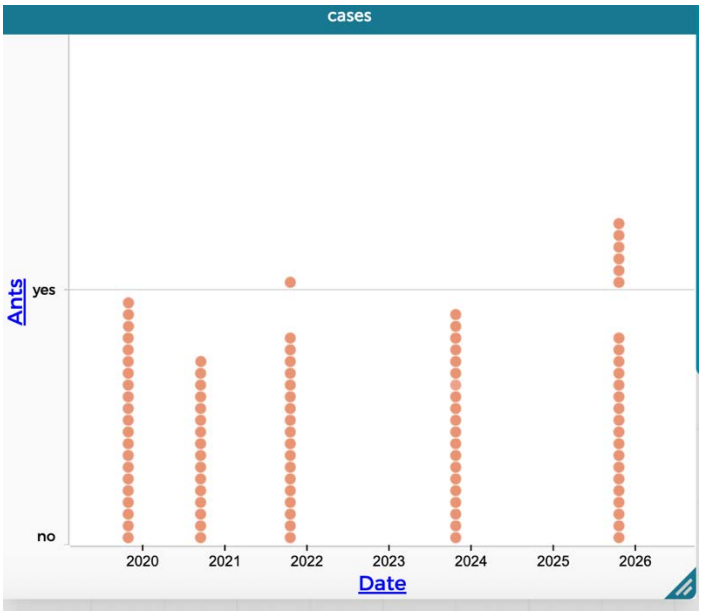
On October 20th, 2025 my class went outside to our knotweed patch in the woods on the right side of the trail. We looked at the latitude and longitude of the patch. The latitude was 44.56 and the longitude was 67.71. The patch has been growing for a long time and it is expanding. We also looked at the height of the patch. We were in groups and everyone had a square of the patch that we had to look at. Our patch's height was 3.2m, which is definitely not the tallest patch of knotweed found but it is definitely around the average. But what makes this so interesting is how knotweed changes over time and it grows fast. It is also very hard to get rid of. For example, if you leave any of the roots of the knotweed in the ground, in about 6 to 10 days you have a brand new knotweed patch.



We also looked at the plant and tried to identify the species. To do that we looked at the shape of the leaf but we noticed it wasn't quite a spade shape or heart shape. Leaving us to the conclusion of it being a hybrid. There also weren't any hairs on the leaf and only Japanese knotweed has no hairs. But really what made me think it was a hybrid was the size. Japanese Knotweed normally ranges from 10 to 12cm and Giant Knotweed normally ranges from 30 to 40cm. But the patch we looked at the leaves were 16cm and hybrids are normally 15 to 20cm. All of this research led me to thinking the patch was a hybrid.

During this project we learned about knotweed psyllids. I am wondering, can psyllids solve our knotweed problem? Knotweed is a plant that has come in invasive and it wont stop spreading until we stop it which is where a psyllid comes in. A psyllid is a tiny fly that eats knotweed, having those in main will kill off knotweed and die the population down. Making knotweed not so invasive. Psyllids are normally tan or orange when they are younger but as they age they

turn more of a darker brown. Psyllids are also considered the jumping plant lice because they suck the juice/life out of knotweed. The best time to use pysllid is in August which is the time knotweed normally grows. But the only problem is there are these ants that live on knotweed that attack and scare away the flies but lately we haven't seen any which is good. But we always have to think about what happens when you bring an animal that isn't made to be there into that state. Who knows, maybe if we bring psyllids to Maine they might become invasive too. But I think if we want to get rid of knotweed, psyllids are the only solution.



References

Cornell CALS. 2021. Japanese Knotweed Psyllid. https://cals.cornell.edu/integrated-pest-management/outreach-education/fact-sheets/japanese-knotweed-psyllid

Portland Press Herald. 2019. Maine Gardener: Knotweed is the thing that wouldn't die https://www.pressherald.com/2019/09/29/knotweed-the-thing-that-wouldnt-die/

Psyllid vs. Knotweed

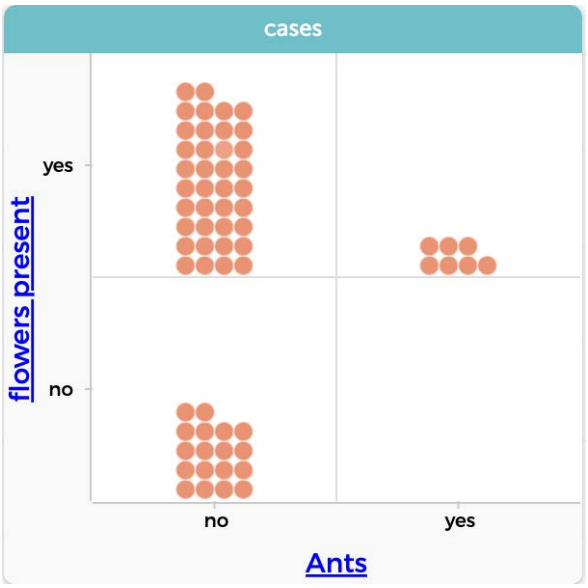
Iris S, Messalonskee Middle School, Grade 7

Japanese Knotweed

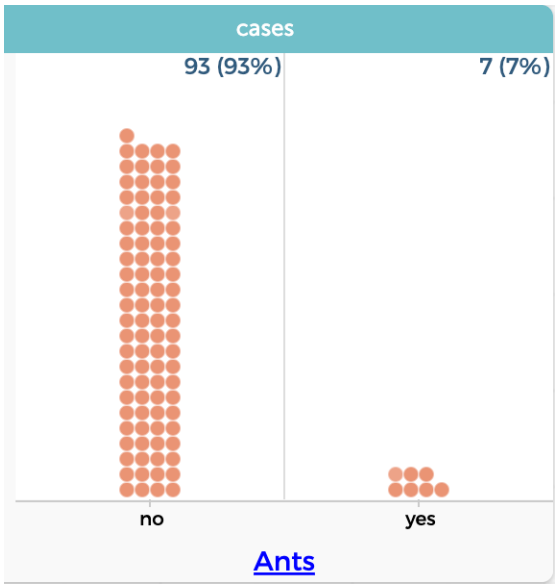
Knotweed Psyllid

Knotweed is an invasive species from Japan, China and Taiwan. There are two main species of knotweed, Japanese knotweed and Giant Knotweed. So, why are we trying to kill knotweed? Knotweed are tall so they block the sunlight from hitting the plants below them. They spread quickly and are extremely hard to kill. When they are moved or disrupted they grow back even more aggressively. Knotweed is invasive in North America and Europe. A knotweed psyllid is a small insect that drinks the sap from knotweed. This causes knotweed to weaken and die. Psyllids don't do well in the cold and many don't last cold winters. Scientists have been working on finding or creating a psyllid to survive colder conditions. A predator to psyllids is the ant. When monitoring knotweed it's important to look for ants because it would reduce the effectiveness of the ants.

On October 20, at 1:10 PM, My school had a knotweed project and we collected data, including whether or not there were ants. We went out onto a trail in the woods and collected data on the knotweed patch beside it. What I found interesting about our data is that we observed more ants this year than in the past. On seven out of one hundred knotweed we found ants. This means that most of the knotweed doesn't have ants. In our data we also found that there were only ants on plants that had flowers, so there could be more ants during the flowering season. However, the problem with introducing a new species is the psyllid could become invasive itself and could harm other plants and animals. So, my question is can knotweed psyllids help control knotweed?



This graph shows that ants were only found on knotweed that had flowers.



This graph shows that out of 100 knotweed plants 7 of them had ants on them.

Scientists are still doing research on how well they will survive in different climates, but it looks like in the near future scientists will release these psyllids into the wild and maybe even sell them. These psyllids will need to adapt to colder climates and ants could eat them, especially during flowering season. Scientists also need to assess the risk of releasing psyllids into different ecosystems. Are you on team knotweed or team psyllid?

References:

Graphs created on https://codap.concord.org/ with Messalonskee Middle School knotweed data.

Japanese Knotweed photo Accessed from https://japaneseknotweed.co.uk/japanese-knotweed/ on November 7, 2025.

Knotweed Psyllid photo. Accessed from https://www.cabi.org/projects/establishing-the-psyllid-field-studies-for-the-biological-control-of-japanese-knotweed/ on November 7, 2025.

Kurose, Daisuke. 2025. Accessed from https://www.cabi.org/projects/establishing-the-psyllid-field-studies-for-the-biological-control-of-japanese-knotweed/ on November 7, 2025.

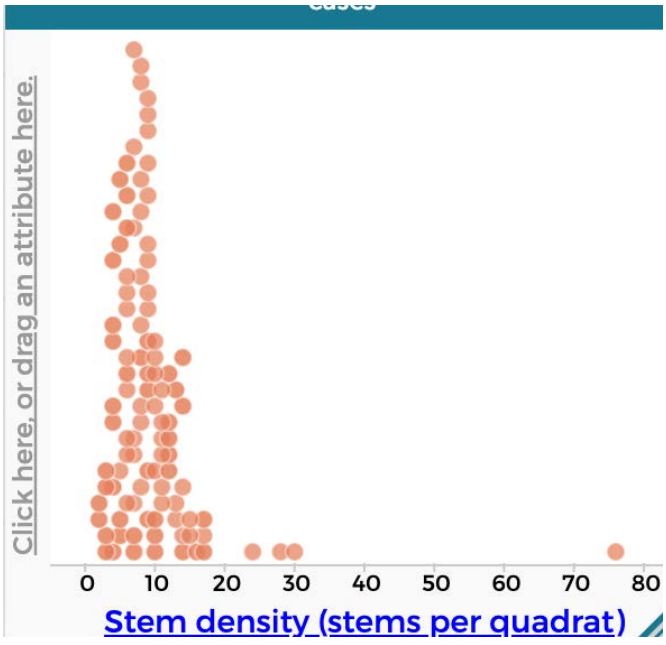
Prade, Patricia. July, 2025. Accessed from https://extension.psu.edu/biological-control-of-knotweed-the-knotweed-psyllid/ on November 7, 2025.

U.S. Department of Agriculture. Accessed from https://www.fs.usda.gov/managing-land/wildflowers/pollinators/who-are-the-pollinators/ants on November 7, 2025.

Japanese knotweed

Nathalie S, Messalonskee Middle School, Grade 7

October 20, 2025 around 1:00, my science class and i went into our school trails and began to research about japanese knotweed. A thing I noticed about this patch of japanese knotweed is there isn't many plants, or a big water source near the patch, and since these plants get so shady, and rough,slightly getting bigger every year.The leaves do not let in a lot of sunlight and space for other plants to live.Japanese knotweed arrived from East Asia over to Maine in the 1800s and was moved to Maine for decoration and was used to help prevent erosion. Since then, because of how easy Japanese knotweed can spread aggressively, it became an invasive species. Japanese knotweed has spread all throughout Maine except for two counties, Piscataquis and Hancock.



Japanese knotweed is a strong, perennial herb/plant that comes out in the early spring, and stops growing in autumn. Japanese knotweed spreads so easily because it can grow in any climate, and if any fragment of the plant that is put in any soil will grow and keep spreading. It can grow in any climate no matter if it's dry, humid, swampy, or forests it will thrive in any of them. Japanese knotweed is adaptable, and has been found growing near or/on structures harming the building making it more weak, and unstable.

Japanese knotweed has/is damaging our ecosystems, roadways, bridges, and native plant species. It is changing the landscape around it, which sets the native ecosystem off balance making it less suitable for much of the wildlife. Originally Japanese knotweed was used to help erosion, but now we are trying to eliminate it because of all the harm it is doing to Maine.

I am still wondering: How do they harm structures so much? Is there maybe another knotweed eating animal we don't know of? How does it still thrive in different climates? I enjoyed learning about Japanese knotweed and invasive species and I want to help reduce the population and fix Maine's ecosystem.

References

https://www.kporttrust.org/japanese-knotweed

https://nyis.info/wp-content/uploads/2024/06/umaine_edu-Bulletin_2511_Japanese_KnotweedMexican_Bamboo.pdf

https://www.mainepublic.org/environment-and-outdoors/2023-10-04/once-considered-ornamental-knotweed-is-one-of-maines-most-damaging-invasive-plants

https://ipm.cahnr.uconn.edu/invasive_plants_japanese_knotweed/

Japanese knotweed and Psyllids

Nya C, Messalonskee Middle School, Grade 7

On October 20th, 2025 my 7th grade science class went outside and looked at different patches of Knotweed. We had to figure out what species it was by looking at the leaf. If you want to know if it is giant or japanese: if it is japanese it will have spade shaped leaves or if its giant knotweed it will have heart shaped leaves. That is one way to tell what type of knotweed it is. We also found the length and how it has changed over time by looking at the past data. The knotweed is growing to be 2-3m tall. Next, I found out that the type of knotweed it was is Japanese. We knew this because it was spade shaped, there were no hairs under the leaf and the whole plant was about 3m tall which is different from giant knotweed. I noticed that knotweed has been growing overtime in different spots and the patches are growing in size. Those are some things we have been looking at.

We wanted to know how our population has changed over time with knotweed and I can tell you some facts about how it has changed. One of the facts is that it starts as a tiny tree and it grows kinda slow but when it is fully grown it is about 3m tall. And then it turns into a full bush. There were only a couple of them around the world but then a hurricane hit and carried it to New England and now it is everywhere. Because people try to get rid of it by tearing it up and throwing it in places but they did not know that it makes it worse and it grows wherever you throw it. That is how it has been changing over the time.

Japanese knotweed is invading Maine and hurting nature and the population of plants. Because it is covering the sun from the other plants so they die. And we have tried to get rid of it is not easy to get rid of. It usually grows back, in about one year. The only way to get rid of it is putting in the hard work which is mowing the lawn a lot or putting chemicals on it. We might be talking about one knotweed species but there are three. One of them is Japanese, but the next one is giant. We also know the last one is hybrid which is a mix of both spices. And be careful when you are mowing because if one of the roots or seeds go anywhere the knotweed will grow anywhere. And never mow on someone else's property because if there is knotweed and you mow it and don't clean your mow and then mow your lawn it could spread to yours then it will be hard for you to get rid of. So you just should look out for knotweed no matter where you are so that is some reasons knotweed is bad for the environment.

I was also asked the question if a psyllid could help the knotweed invasion? Just so you know what a psyllid is, it is a small bug that eats the plants and the juice of the plant so if we add more psyllids then they will eat the knotweed and potentially stop the knotweed from growing. But the knotweed needs to be cut a lot and if they just eat it once and then go to another plant then it will easily grow back. But they could also eat other plants and then there will not be a lot of plants around which will not be good for the ecosystem. So a psyllid could be the next invasive thing to Maine because they are originally located in Eastern Asia. That is all the facts I have about knotweed and psyllids.

Reference

Portland Press Herald. 2019. Maine Gardener: Knotweed is the thing that wouldn’t die https://www.pressherald.com/2019/09/29/knotweed-the-thing-that-wouldnt-die/

Hemlock Woolly Adelgid

Paige L, Jordan-Small Middle School, Grade 8

Intro

The Hemlock Woolly Adelgid is a small, white, fuzzy egg that attaches itself to the bottom of a hemlock tree. This species originated from China and Japan and is very easily spread. Over the course of 20 years, the Agelgid has spread all over eastern North America. The Adelgid is most commonly found in forested areas, where people go to hike or be in the woods. It's able to be found year-round, and this winter, me and my classmates made observations three times, checking on the Hemlock that was spotted behind my school and was in an undeveloped area off of a cross-country trail. This species is known to completely take all of the trees' nutrients over the course of five years. When checking for HWA, make sure you have correctly identified that it's a Hemlock tree or else it won't have Adelgid. One easy way to check is by looking at the underside of the tree's small leaves; if the bottom has two lines, a Hemlock has been correctly identified. The weather this winter was very cold, and the third time I checked my Adelgid tree, the HWA had all died over the past few months.

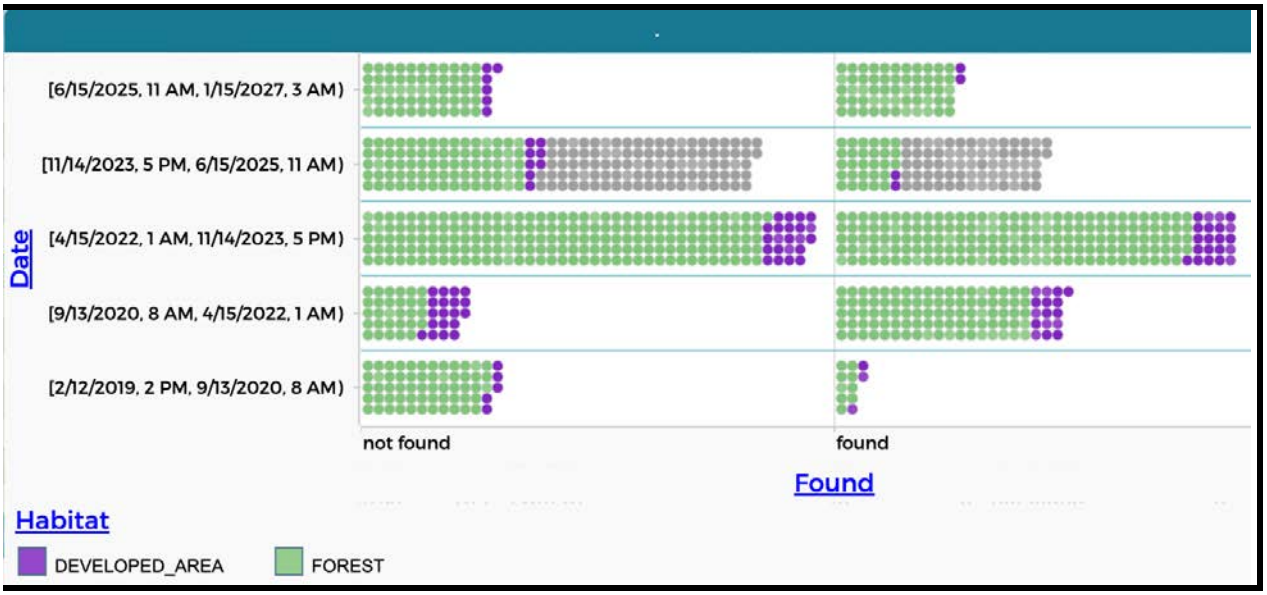
Features and found

I've been influenced to write about the HWA and have found solutions to some of the problems. To help calm down or even completely stop the spread in the area, you can release the small 2-3mm black beetle bugs (*Laricobius nigrinus* and *Sasajiscymnus tsugae*). It is called a specialist predator because it's extremely particular with the food it eats, and it does so because it only feasts on the adelgid, which helps control their spread. Another prevention is awareness, putting up signs and telling people what could help may just be the key to help. In Cumberland County, the hypothesis is that the HWA had started on a small island in Raymond, called Frye Island, due to people climbing the rocks and being in the woods. Many come to find that the HWA attacks your clothing and then spreads to other places in the area. Lastly, don't get confused by its look-alikes. The Adelgid is commonly mistaken for Spittle bugs, Spider egg sacks, and Oak Skeltonizer. When looking, the clues that indicate it is an agelgid are its small fuzz throughout the whole branch, and the attachment is at the base of the needles, not just in the middle of the branch. With proven data with a graph, you are most likely to find the HWA in a forested and not a developed /forrest area.

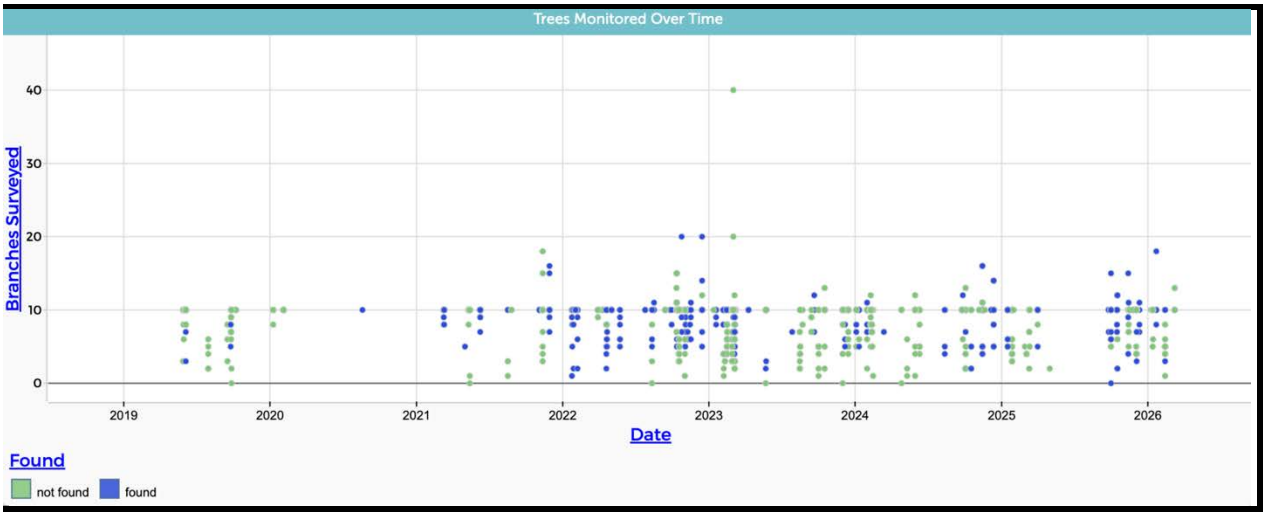
Conclusion

Based off what I already know, trying to get the word out that in Cumberland County, ME, and people in the community know about this impactful investigation, that maybe next year, during the time when the eggs are mostly commonly seen, hopefully the rate will go down. In 2027,

when this gets further investigated, I can't wait to see the data! (december 12, feb 13, and March 19th)



This graph represents the habitat where the HWA has been found; the green is a forested area, and the purple is a developed area. The grey is an unlisted habitat. When looking at the graph, in 2022, the HWA was observed to be larger than the others; the rate is way different from 2019 to 2022. This sparks a question. Since three years ago, the data skyrocketed. What will happen this year?



This graph shows the number of branches surveyed over time, the green dots represent HWA that has not been found and the blue dots mean that HWA has been found. Where they are on the graph is the number of branches looked at, so if the dot is in the middle of 0-10, the green dot would mean 5 branches have been surveyed.

In the images above, these are the organisms that are commonly mistaken for HWA.

This is Hemlock Woolly Adelgid.

References

Hemlock woolly adelgid overview. (n.d.). Retrieved April 14, 2026, from Maine.gov website: https://www.maine.gov/dacf/mfs/forest_health/insects/hemlock_woolly_adelgid_overview.htm

Home and garden IPM from cooperative extension. (2013, March 19). Retrieved April 14, 2026, from Home and Garden IPM from Cooperative Extension website: https://extension.umaine.edu/home-and-garden-ipm/fact-sheets/common-name-listing/hemlock-woolly-adelgid/

(N.d.). Retrieved April 14, 2026, from Mcht.org website: https://www.mcht.org/impact-stories/news-and-publications/press-releases/invasive-alert-hemlock-woolly-adelgid-is-now-prevalent-and-spreading-along-maines-coast/

CODAP research data: https://codap.concord.org/releases/latest/static/dg/en/cert/index.html#shared=108103

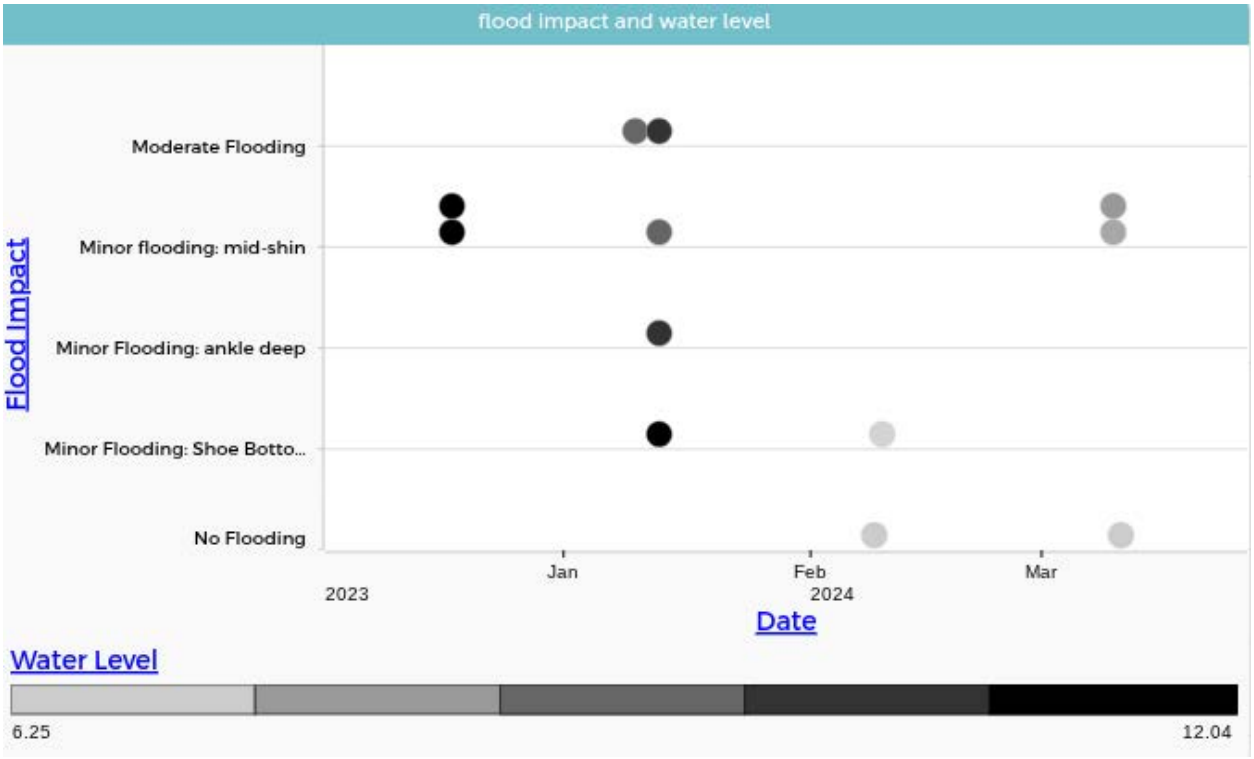
How does water level affect flood impact?

Juniper B, King Middle School, Grade 7

Introduction

The question I am investigating is How does water level affect flood impact? The water level is rising because of global warming which causes sea level rise. Businesses and communities will be negatively affected. Maine is both warmer and wetter than 100 years ago. Portland needs to prepare for floods because the floods have been some of the worst recorded in Maine. The data I am using is date, water level, and flood impact. It comes from GMRI's Ecosystem Investigation Network. Community scientists collected this data in the Bayside neighborhood of Portland, Maine. I am using this data to investigate my question because it can help me understand how water level can impact flood impact. Additional information I would like to have is what exact days these floods happen.

Graph



Water level is measured in feet.

Discussion

I notice in the data that in January when the water is high the flood is worse. I can see on my graph that the time is 2023-2024. Based on this data, what I think about my question is when the water level is high, it sometimes floods more. I want to investigate further because I wanna know what type of tide they were like king tide, spring tide, etc.

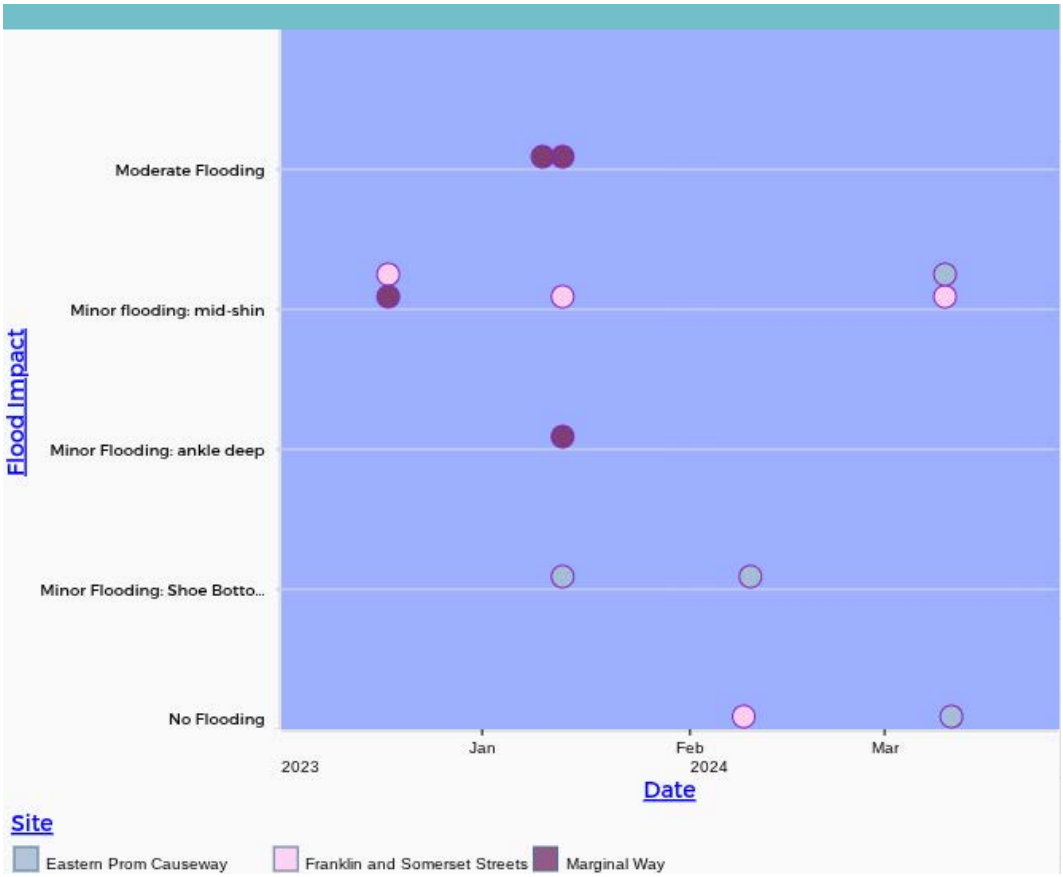
Photo

This is flooding Portland Maine. Not from stormwater. Date: 1/10/24, Site: Marginal Way

What sites have the most flood impact in Bayside?

Grace N, King Middle School, Grade 7

The question I am investigating is what sites have the most flood impact in Bayside? The data I am using is date, site, and flood impact. It comes from GMRI's Ecosystem Investigation Network. I am using this data to investigate my question because it can help me understand why it was the worst flood event and how damaging it can be and can help the community to stay aware of floods in the area and to find safer shelter for protection. The way I collected this data was I use GMRI's Ecosystem Investigation Network and want the graphs tabs and put in choose 3 options Flood impact to see how impacted the area is, Sites to see where the flooding happens, Date to know when it happens to make a prediction it for the next years. Additional information I would like to have is where was the worst flooding 2 years ago.



I notice in the data that there is only one dot that represents Marginal Way on the ankle deep. I can see on my graph that Franklin and Somerset Streets had no flooding during Feb 2024. This data stands out to me because it is in the no flooding zone, there is no dot(s) for Marginal Way or in January. Based on this data, what I think about my question is Marginal way one of the sites that has the most flood impact. This makes me wonder why there is no higher flood impact than moderate?

Photo

Date: 1/10/24 **Site:** Marginal Way

This is Marginal way on January 10, 2024 showing that in January Marginal Way had Moderate flooding the most flood impact and I know this because there are purple dots that represent Marginal Way in the January zone.