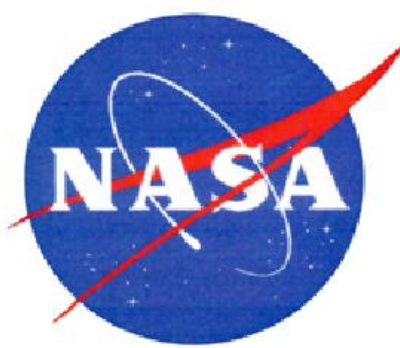
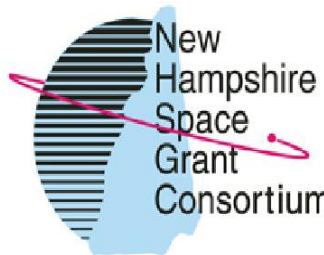


# How Gilmanton's White Pine Trees' Health Compare to the Health of Trees on Other Sites



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## Introduction

We are conducting this investigation to discover how healthy Gilmanton's White Pine Trees are compared to other sites. Other sites that we will look at are Concord, Salem, Rye and Cape Cod. Some of the factors that we will compare are Total Percent Damage, Red Edge Inflection Point, Needle Length, Needle Retention, Thematic Mapper Broad Band Reflectance 5/4, Near Infrared Narrow Band 3/1, and Symptomology.

We think that the results will tell us that Gilmanton's trees are as healthy or more healthy than other sites. We think this because we live in a rural, forested area away from big cities and harmful ocean air currents.

## Materials and methods

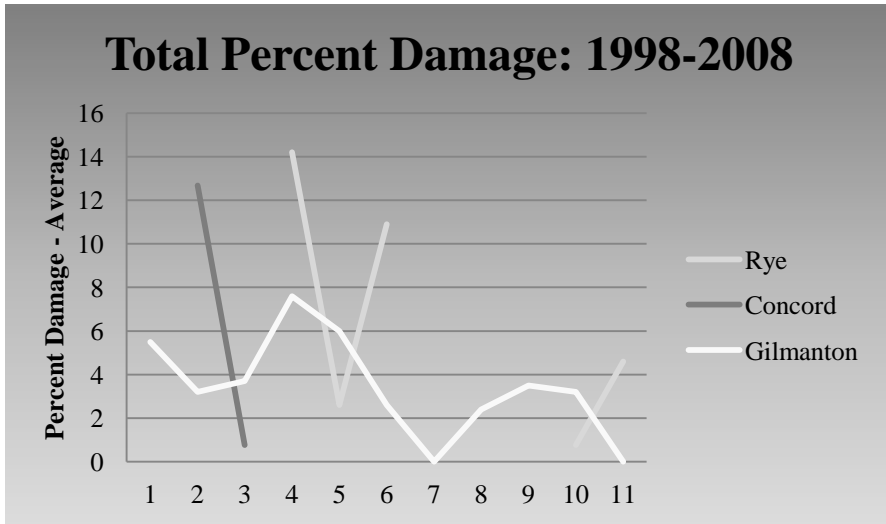
Gilmanton's data set for Trees 371-375 go back to 1996. We chose to look at Concord and Salem because their trees are located in the city and may be subject to pollution from cars and industry. Cape Cod Academy and Rye's trees are located closer to ocean and may be influenced by pollutants relocating due to local wind patterns.

## Results

There were several comparisons that we felt were most critical in helping us determine how healthy our trees are compared to other sites in New England.

The first analysis that we completed was to look at Total Percent Damage.

Years	Rye	Concord	Gilmanton
1998			5.5
1999		12.68	3.2
2000		0.76	3.7
2001	14.2		7.6
2002	2.6		6
2003	10.9		2.6
2004			0
2005			2.4
2006			3.5
2007	0.76		3.2
2008	4.6		0

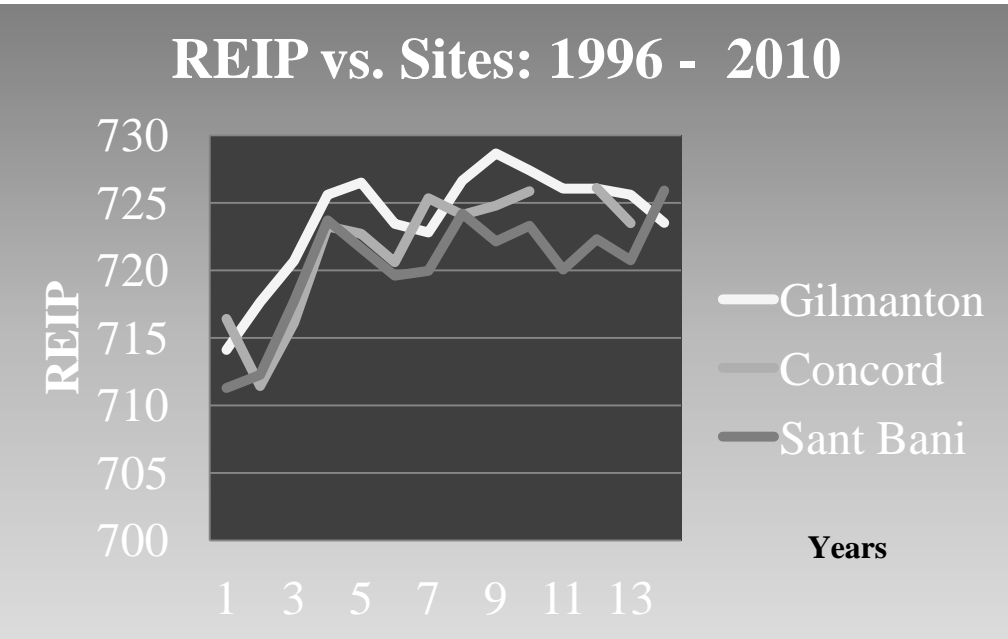


These results tell us that Gilmanton's trees were damaged, sometimes affected the most, sometimes the least. The data is very scattered.



Next we asked the question: What is the Red Edge Inflection Point In Gilmanton compared to other sites?

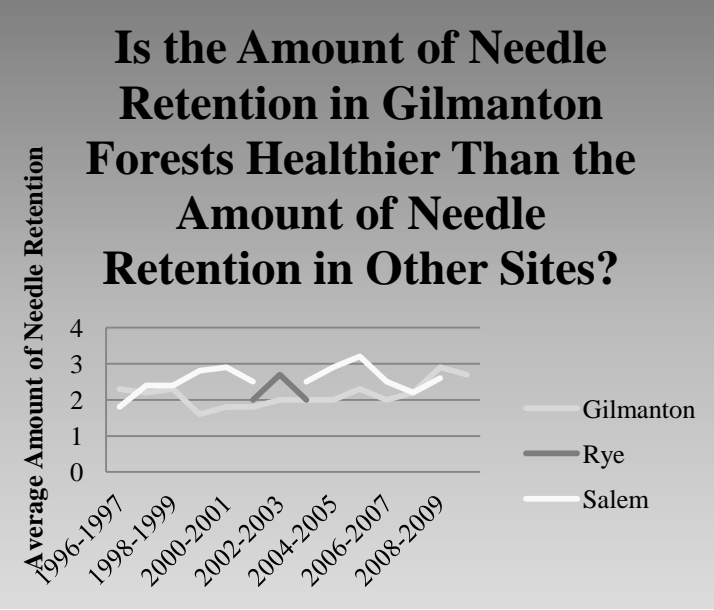
REIP vs. Sites: 1996 - 2010			
Year	Gilmanton	Concord	Sant Bani
96-97	714.1	716.4	711.3
97-98	717.65	711.43	712.27
98-99	720.7	716.1	717.7
99-00	725.6	723.25	723.7
00-01	725.5	722.7	721.63
01-02	723.45	720.6	719.6
02-03	722.8	725.35	719.95
03-04	726.65	724.1	724.2
04-05	728.65	724.8	722.15
05-06	722.6	725.85	723.1
06-07	726.05		720.05
07-08	726.05	726.1	722.3
08-09	725.59	723.5	720.75
09-10	723.525		725.91



White pine needles that are healthy have a REIP over 712. All of the needles from Gilmanton, Concord and Sant Bani appeared healthy throughout this study.

We wondered: Is the amount of needle retention in Gilmanton's forest healthier than the amount of needle retention in other sites?

The Average Amount of Needle Retention for the Sites of Gilmanton, Concord, and Salem Over Time			
Years	Gilmanton	Rye	Salem
1996-1997	2.3		1.8
1997-1998	2.2		2.4
1998-1999	2.3		2.4
1999-2000	1.6		2.8
2000-2001	1.8		2.9
2001-2002	1.8	2	2.5
2002-2003	2	2.7	
2003-2004	2	2	2.5
2004-2005	2		2.9
2005-2006	2.3		3.2
2006-2007	2		2.5
2007-2008	2.2	1.9	2.2
2008-2009	2.9		2.6
2009-2010	2.7		



Needle retention in our forests is very important because we need to know how long a tree has hung onto their needles. If trees did not hang onto their needles for very long, then they would not be able to produce as much chlorophyll and it must be an unhealthy tree. These results tell us that Gilmanton's needle retention is healthier than it is in other sites. Gilmanton's total average needle retention from 1996-2010 was 2.56, Rye's was only 1.7, and Salem's was 2.50.



Collecting our samples and finding Wet Weight/Dry Weight.

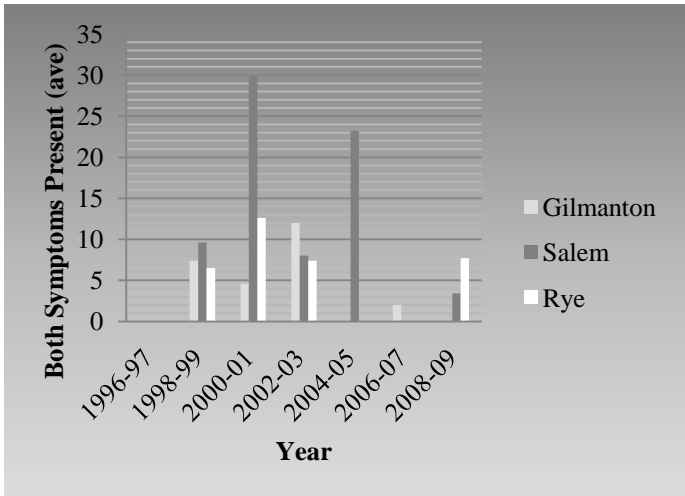


Heading into the woods to collect our samples



Which site showed more of both symptoms present on the same needle on average from 1996 to 2009?

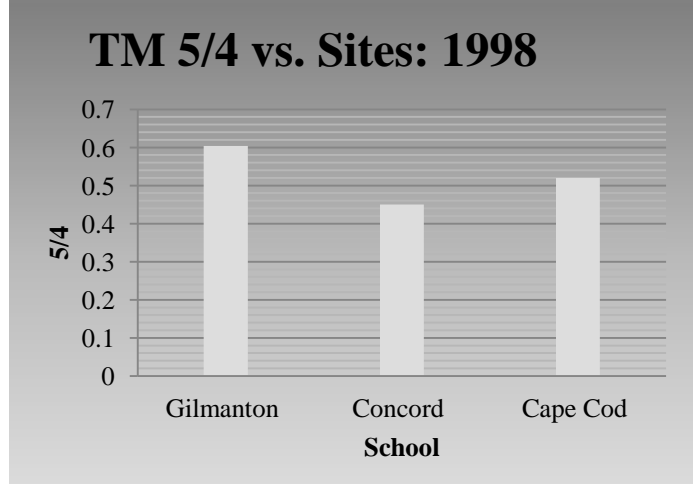
Both Symptoms Present on the Same Needle: 1996 - 2009?			
Year	Gilmanton	Salem	Rye
1996-97	0	0	
1998-99	7.4	9.6	6.5
2000-01	4.6	29.9	12.6
2002-03	12	8	7.4
2004-05	0	23.2	
2006-07	2	0	
2008-09	0	3.4	7.7



Tropospheric Ozone Damage can cause symptoms on needles in white pine. If tip necrosis and chlorotic mottle are present on the same needle, we can say, with reasonable certainty that this damage was caused by O<sub>3</sub>. These results show that Rye has the most visible damage during the years reported, followed by Salem. Gilmanton's needles seemed the most healthy.

Finally, we wanted to know: Is there a difference in water stress in Gilmanton trees compared to other sites in 1998, the hottest year in our record?

TM 5/4 vs. Sites: 1998			
Year	Gilmanton	Concord	Cape Cod
1998	0.604	0.45	0.52



Tm 5/4 is an indicator of water stress. Below .55 indicates good water levels in vegetation. Above .60 tell us that the needles are under stress. These results tell us that Gilmanton had .604 water stress. As you can see, Concord and Cape Cod's needles had good levels of water, while Gilmanton's were slightly drier.



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## Conclusions

We conducted this investigation because we wanted to find out how healthy our trees were in comparison to several other school sites.

One of the problems that we had was that while Gilmanton had a complete data set from 1996 through 2010, other sites did not. This caused us to make some assumptions. Another problem was that we did not know the exact location of the site. How far in from the ocean were Rye and Cape Cod Academy's sites? Was the Concord site really in the city or was it closer to the Merrimack River?

With that said, we started out believing that our trees would be healthier overall than other sites because we live in a rural area. This is not necessarily what we found. When we compared our overall Percent Damage to Rye and Concord, we found that on average, Gilmanton's trees had the most damage. Gilmanton, as well as other sites, maintained high REIP points, another indicator of health, throughout the study and held onto needles longest.

When looking for both symptoms on needles, Gilmanton's showed the least visible symptoms of chlorotic mottle and tip necrosis. During the hottest year, Gilmanton's needles were able to maintain a high REIP while showing signs of water stress and holding onto needles.

We wondered if maybe trees in different environments have managed to figure out a way to adapt to the stresses put on it by different environmental conditions. This raised a number of other questions: Does the proximity to the ocean and a constant source of water in the air affect the amount of canopy (which would affect the amount of chlorophyll being produced)? Does the terrain, the slope of the land, the flatness, the amount of standing groundwater, affect the overall health of the trees? We looked at the hottest year in terms of water stress, but, what about the rainiest summers? How would those same trees be affected by unusual amounts of rainfall or cloudy days?

## Literature cited

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## For further information

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