Is There a Relationship Between Weather and Our Trees' Health?

Michael Bugnaki, Jacob Forst, Mekayla Collett, Lexi Jakubens, Jayme Strzepek, Audrey Malek, Dylan Tiede, Cortlynn Danby, Sarah Tasker, Bobby Barton

Introduction

We are conducting this investigation in order to find out if there is a relationship between weather and tree health. We think that certain types of weather such as High Ozone Exceedence Days, Carbon Dioxide, Precipitation and Temperature.

We believe that there is a relationship between weather and tree health; too much water might kill or damage a tree the same way that little water will damage or kill a plant.

Since plants take too in CO_2 and give off O_2, we think that as CO_2 increases in the atmosphere, our needles and trees will get healthier.

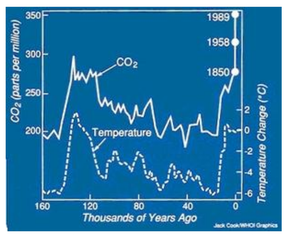
We think that more High Ozone Exceedence Days will cause more damage to our needles.

We are not sure what effect temperature will have on our trees other than really hot days and really cold days drying out and damaging the needles.

Audrey taking dbh measurements.

Materials and methods

The comparisons that we made to explore this question include comparing precipitation data for New Hampshire to Needle Length and Water Content, Temperature data for New Hampshire to Needle Length and Total Percent Damage, High Exceedence Days to Total Percent Damage, to needles containing both Chlorotic Mottle and Tip Necrosis, to Water Content, and to Needle Retention. We also compared Carbon Dioxide to Total Percent Damage and Needle Length.



http://smarteconomy.typepad.com/smart_economy/images/vostok_ice_core_temp_and_co2_pppm.jpg

Results

We conducted this investigation to find out if there is a relationship between weather and tree health in Gilmanton, NH.

First we examined data for Temperature Averages for New Hampshire and Percent of Total Damage on our white pines.

Is There a Pattern Between the Average Temperature and the % Total Damage of White Pine Trees?		
Year	Ave. Temperature(F°)	% Total Damage
1998	46.6	5.5
1999	45.8	3.2
2000	43.3	3.7
2001	45	7.6
2002	45.2	6
2003	43.2	2.6
2004	43.6	0
2005	44.4	2.4
2006	46	3.5
2007	43.3	3.2
2008	43.8	0
2009	43.1	3.7

This graph shows that the warmer the temperature, the more damage showed up in our needles.

Next, we wanted to find out if the amount of rain and precipitation would affect the amount of water stored in the needles.

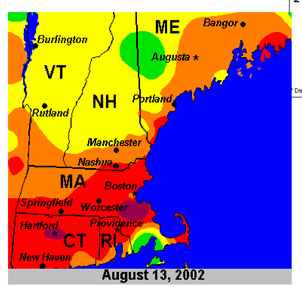
Does the Amount it Rains or Snows Relate to How Much Water is in the Needles?		
Dates	%Water Content	Ave Precip
1996	61.38	50.8
1997	59.3	62.14
1998	52.4	48.24
1999	55.5	58.9
2000	51.3	60.79
2001	53.7	41.85
2002	54.9	47.79
2003	57	43.03
2004	60	33.44
2005	58.4	46.04
2006	54.5	44.93
2007	54.2	45.36
2008	55.39	40.37
2009	46	53.76

This graph shows us that the less precipitation, the more the needles held onto their water.

Then we examined the relationship between High Ozone Exceedence Days and the percent of needles that showed both chlorotic mottle and tip necrosis on the same needle (an indicator of tropospheric ozone damage).

The Effect Of the O_3 Exceedence Days On the Amount of Both Symptoms		
year	ozone exceedence days	% both symptoms
1998	14	7.4
1999	19	5.4
2000	5	4.6
2001	22	5.7
2002	23	12
2003	10	8.1
2004	10	0
2005	17	0
2006	10	2
2007	22	0
2008	8	0

The results of this data show us that the more Ozone Exceedence Days in the year, the more needles that have both symptoms.



We then asked the questions: Does High Ozone Exceedence Days affect the total damage on our needles?

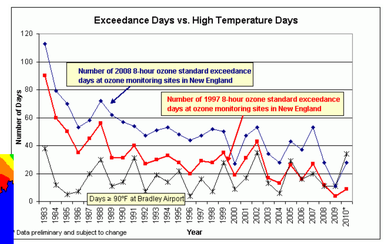
YEAR	HIGH Ozone Days	% DAMAGE
1998	14	5.5
1999	19	3.2
2000	5	3.7
2001	22	7.6
2002	23	6
2003	10	2.6
2004	10	0
2005	17	2.4
2006	10	10.7
2007	22	3.2
2008	8	0.153
2009	2	3.633

These results tell us that the higher the Ozone Exceedence Days are, the higher the Total Percent Damage.

Then we looked at Carbon Dioxide in the atmosphere and wondered if that would affect our needles.

If There is More Carbon Dioxide will the Amount of % Damage Rise?		
Year	Average % Damage	Average Amount Of Carbon Dioxide (ppb)
1998	6	366
1999	3	368
2000	4	369
2001	8	371
2002	6	373
2003	3	376
2004	0	378
2005	2	380
2006	6	382
2007	3	384
2008	0.1	386

These results were interesting because what they tell us is that there is more damage to our needles in general with less amounts of Carbon Dioxide in the atmosphere.



http://www.epa.gov/ne/airquality/graph.html

Conclusions

Our hypothesesis was that the weather would affect the health of our white pines. Our investigation shows that weather does have an effect on our trees.

We found that as temperature and High Ozone Exceedence Days increased, so did the damage in our needles.

It seemed that in years when there was more precipitation, the needles held onto their water more.

The other interesting finding was that when there was more Carbon Dioxide in the atmosphere, our needles tended to be healthier.

These findings lead us to several new questions:

Does the amount of direct sunlight a pine tree gets each day affect it's growth?

Is temperature affected by Carbon Dioxide levels in the atmosphere?

How much damage does too mu ch or too little water in a needle affect the overall health of the needle?

Remember: **no period** after journal name (unless you us abbreviation).

Literature cited

Acknowledgments

We thank I. Güor for laboratory assistance, Mary Juana for seeds, Herb Isside for greenhouse care, and M.I. Menter for questionable statistical advice. Funding for this project was provided by the Swarthmore College Department of Biology, a Merck summer stipend, and my mom. [Note that people's titles are omitted.]

For further information

Please contact *mfougere@gilmanton.k12.nh.us* or Martha Carlson at *forestwatch@sr.unh.edu.*

More information on this and related projects can be obtained at **http://www.forestwatch.sr.unh.edu**.