NH Education and Environment Team

NH Field Investigations Model

Winter Severity Index
NH Fish and Game Department

NH Education and Environment Team

The NH Education and Environment Team (NHEET) is a public-private collaborative of state-based, teacher professional development providers in the fields of environmental education, natural science, and scientific inquiry. Members include the GLOBE Program, Project HOME, Project Learning Tree, Project WET at NH Department of Environmental Services, Projects WILD and Aquatic WILD at NH Fish and Game Department, and the US Forest Service. Our mission is to support schools and teachers to provide their students with the resources and opportunities to be skilled and knowledgeable stewards of our natural environment.

Using Field Investigations to Model Scientific Inquiry

State and national science standards emphasize the importance of inquiry and problem-solving for today's students. Field investigations offer rich opportunities for students to practice inquiry in engaging and authentic ways. Key steps in field investigations mirror the inquiry process. They are posing research questions, planning and conducting investigations, using evidence to describe findings, communicating research findings to target audiences, and asking new research questions based on findings.

Field Investigations in NH

Just as New Hampshire is gifted with abundant natural resources, so too do we benefit from plentiful scientific field investigations. Several ongoing investigations are offered as models to guide teachers and their students through an authentic scientific inquiry process.

This model describes the Winter Severity Index, which provides a subset of data used by the NH Fish and Game Department to assess how the severity of winter may impact deer populations. This model is recommended for middle school use.

Two related models are recommended for high school use. One provides maximum and minimum air temperature data collected at Hubbard Brook Experimental Forest. The other provides precipitation collected at several rain gages at Hubbard Brook.

A model for elementary school use presents data on the species of birds observed through Project Feeder Watch. (This model is still in development.)

All models and accompanying spreadsheets and information are available at www.nhplt.org. Funding for their development and distribution was provided by the federal Math-Science Partnership grant program.

Field Investigation Design

Research Question

How will the severity of winter impact the deer population in each wildlife management unit each year?

How Does the Data Answer the Question?

The Winter Severity Index (WSI) is used by wildlife biologists in New Hampshire and other northern states with snow to estimate the effect of winter conditions on white-tailed deer populations. Deer are often unable to find the food they need in winter to meet their daily nutritional needs. They rely on fat reserves accumulated in the fall and both physical adaptations and behavioral strategies that conserve energy to help them survive the winter. Deer grow a thick hollow-haired coat that insulates to about zero degrees Fahrenheit. Below that temperature deer need to burn calories from their stored fat to maintain their body temperature. Deer have a belly height of about eighteen inches. When snow depth reaches or exceeds that height it takes significantly more energy for deer to move about, resulting in the burning of stored fat. When winters are especially severe, deer may deplete their fat—or stored energy reserves—and begin to starve. If the snow lingers on the ground through April, access to new food, in the form of emerging green shoots, may be delayed long enough to result in the starvation of thousands of deer depending on the extent of the area affected by the severe winter conditions. Additionally, surviving pregnant does that are in poor nutritional condition may spontaneously abort their young, reducing the reproductive rate of surviving deer.

Using snow depth and minimum temperature data collected daily in each Wildlife Management Unit (WMU), biologists are able to predict approximately how many deer will survive the winter and from that, estimate the number of young expected to be born. Considering the need to maintain stable populations of deer in each management unit, biologists use the data to make recommendations for that fall's harvest or hunting season. The number of deer harvested in a given management unit is maintained by adjusting the number of antlerless (doe) deer permits available to hunters. The data comes from a number of sources, including national weather service sites and citizen collected data.

Data Collected

Daily Snow Depth and Minimum Temperature Data

Data Source

NH Fish and Game Department

Primary Contact

Mary Goodyear
Wildlife Educator
NH Fish and Game Department
11 Hazen Drive
Concord, NH 03301
mary.goodyear@wildlife.nh.gov

A middle school curriculum is available to guide teachers in the Winter Severity Index data collection program.

Begin date

2002

End data

Ongoing

About the Data

The data set includes a Microsoft Excel spreadsheet with monthly and annual Winter Severity Index (WSI) data collected at participating schools throughout New Hampshire from 2002-2008. The data is provided in separate spreadsheets by year and also combined for all years into one spreadsheet. This allows teachers to provide subsets of data to students as appropriate. WSI data is collected according to an established protocol at each participating school from December through April. The Wildlife Management Unit (WMU) for each school location is also noted, as is the number of bucks harvested by hunters in each school's corresponding WMU during the fall hunting season following the winter in which data was collected. A state map with the WMUs outlined is also provided.

Study Protocol

Data collection is an integral component of a wildlife management curriculum unit designed for middle school students by NH Fish and Game Department staff. (The *Winter, Weather and White Tailed Deer* curriculum is available upon completion of the Winter Severity Index data collection agreement.) The NH Fish and Game Department provides maximum/minimum air temperature thermometers, snow stakes and data collection sheets for use at schools where teachers have agreed to have students collect data.

Notes on Data

The size of the fall deer population is estimated by examining the number of bucks harvested (shot), the average reproductive rate of does and the sex ratio of females to males in a population.

The following formula is one way used to estimate the total deer population prior to the fall hunting season.

1. Take the total buck harvest for a year and multiply by 2.5, because approximately 40 % of the adult bucks are harvested during the fall hunting season. This gives an estimate of the total buck population.
2. The ratio of adult does to adult bucks is 2.5:1. Multiply the total number of bucks from step one by 2.5.to get the number of does.
3. The average reproductive rate of does in New Hampshire is 0.7 fawns per adult doe in the fall. Multiply the number of does from step two by 0.7.to find the estimated fawn population.
4. The total deer population before the fall hunting season is determined by adding the number of bucks, does and fawns.

For example:

If the number of bucks harvested is 10, the estimated total number of bucks is 2.5x10=25

There are 2.5 times as many does as bucks, so the estimated total number of does is 2.5x25=62.5 (round up to 63).

Does reproduce at a rate of 0.7 so the estimated total number of fawns is 7x63=44.1 (round down to 44).

Estimated total deer population is Bucks + Does + Fawns or 25+63+44= 132

These figures may be used to compare the total deer population prior to and after an antlerless deer season, a severe winter or for different years in New Hampshire.

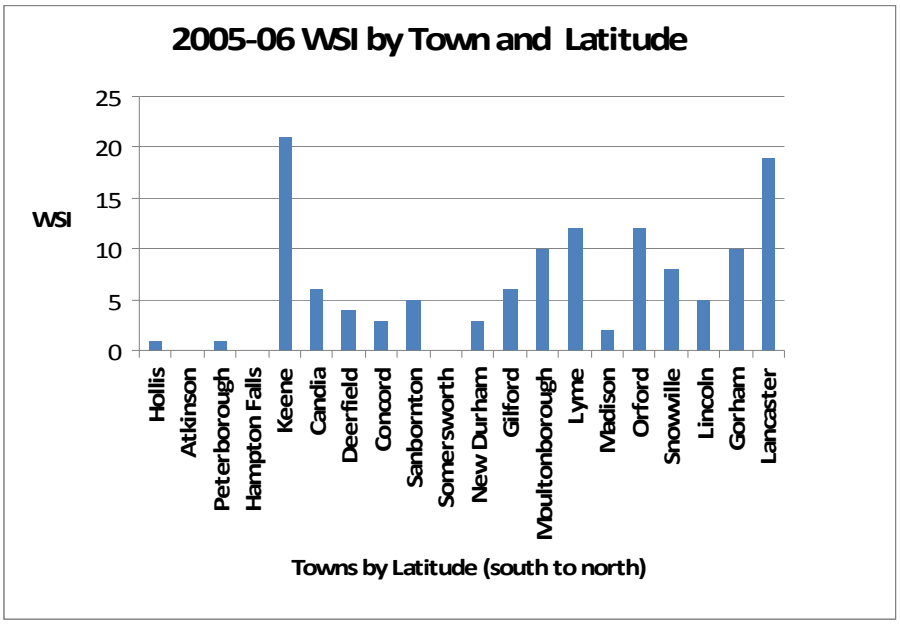
Examples of Questions for Data Analysis

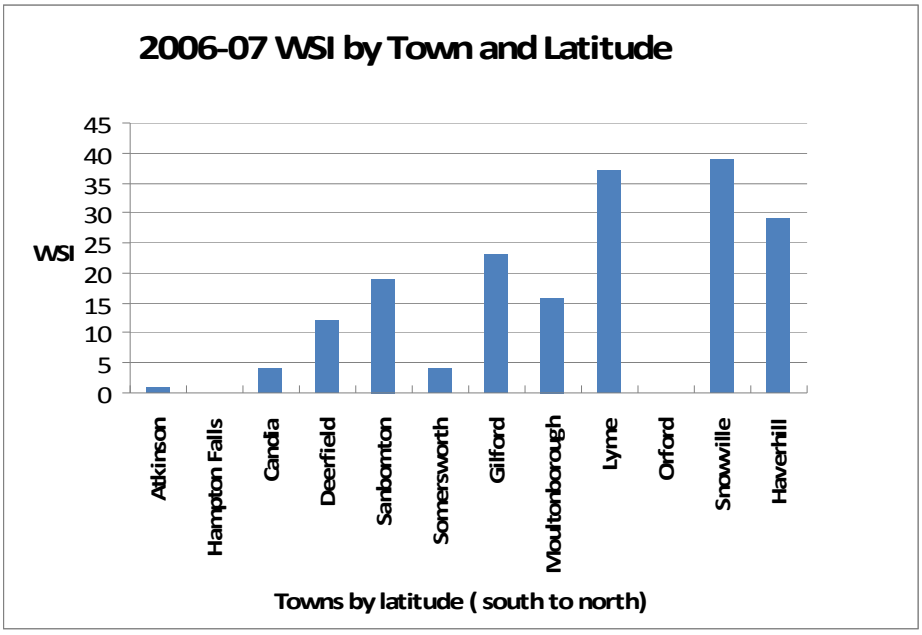
- As you analyze your graphs, do any patterns stand out? If so, how would you describe them? What kinds of questions do you have about these patterns?
- Based on the information in the datasets, which month would you predict would have the most severe winter conditions at your school?
- Based on the information in the datasets, what would you predict your winter severity index might be at your school this year? (Students could be asked to give a reasonable range.)
- Do you think the winter severity index will be the same each year at a particular site? Why?
- How does the winter severity index change over the course of the winter?
- How does the winter severity index in northern NH compare to that in southern NH? How does the WSI in interior NH compare to that near the seacoast? Do you see changes in these patterns from year to year?
- In the 2005-06 graph, which town stands out as "outliers"? (An outlier is an observation in a dataset which is far removed in value from the other data. It is an unusually large or small value compared to the others.) How might you explain this outlier?
- Do any years stand out as unusual to you? Why?
- Look at the winter of 2007-08. Does the range of severity of the winter among the towns represented follow the same pattern as in previous years? How would you describe the difference this year? What do you think might have happened to cause the difference?
- In a year when the WSI is low in a particular region, what changes would you predict would be seen in the deer population in that region during the following fall?
- Based on the information in the dataset, in which year do you think there would be the lowest population of deer in the state?; in which year the highest?
- Do you see any patterns that you are wondering about? Can you think of other ways to graph this data? What other questions do you have about the data?
- How can you explain any anomalies in the deer harvest data from what could be expected from the WSI? (snow on ground during the hunt enhances tracking ability; cold, wet weather keeps more hunters at home; availability of places to hunt; road kill, etc.)

Examples of Charts and Graphs

Example 1: These charts were created using the bar graph function in Microsoft Excel. Data were prepared for graphing by selecting the "latitude" column and using the sort function to sort from lowest to highest latitude. This sorting arranges town names and WSI information in order from south to north. Using the bar chart option, the Total WSI was selected as the data source and the "town" column was selected as the x-axis label.

Students may sort data by year and graph it for a particular year for each school site represented. Latitude for each town represented is included in the data set as an example of a way students may compare different sites and look for patterns. Other variables to consider include elevation, east versus west location, proximity to mountains, the seacoast, lakes and other physical features. Students may need to research the variables for the towns represented. Students may locate and mark the towns on a state map to assist in visualizing some of the variables.

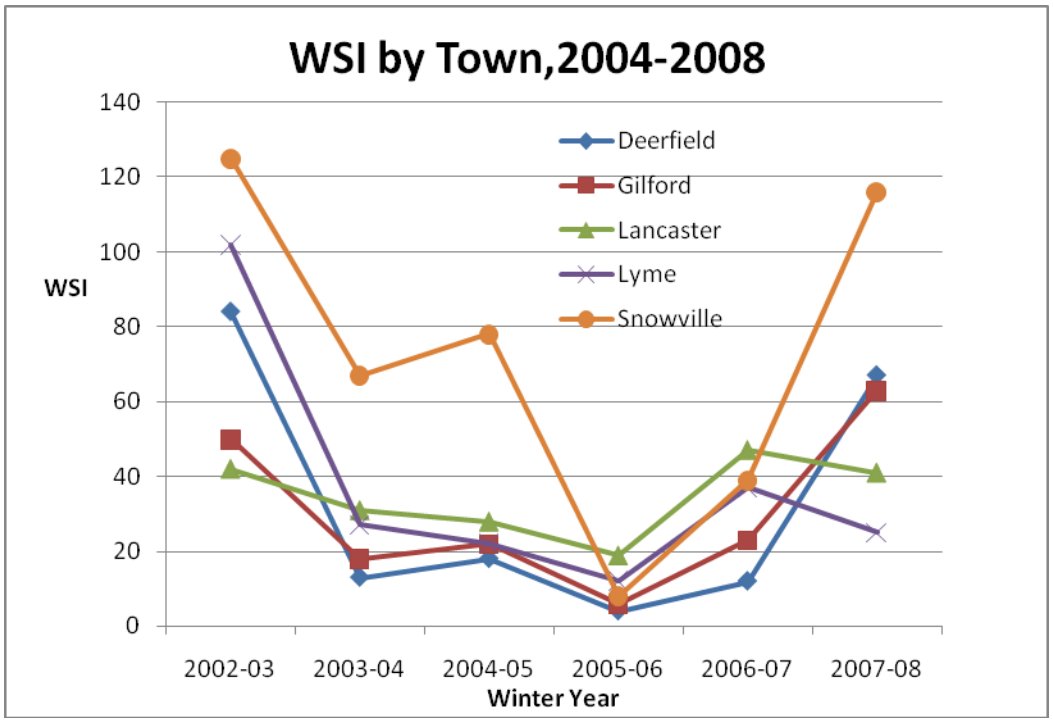




Example 2: Another way to look at data across the state is to choose several different locations and graph the yearly WSI figures for each over time. The data for each town may be graphed as

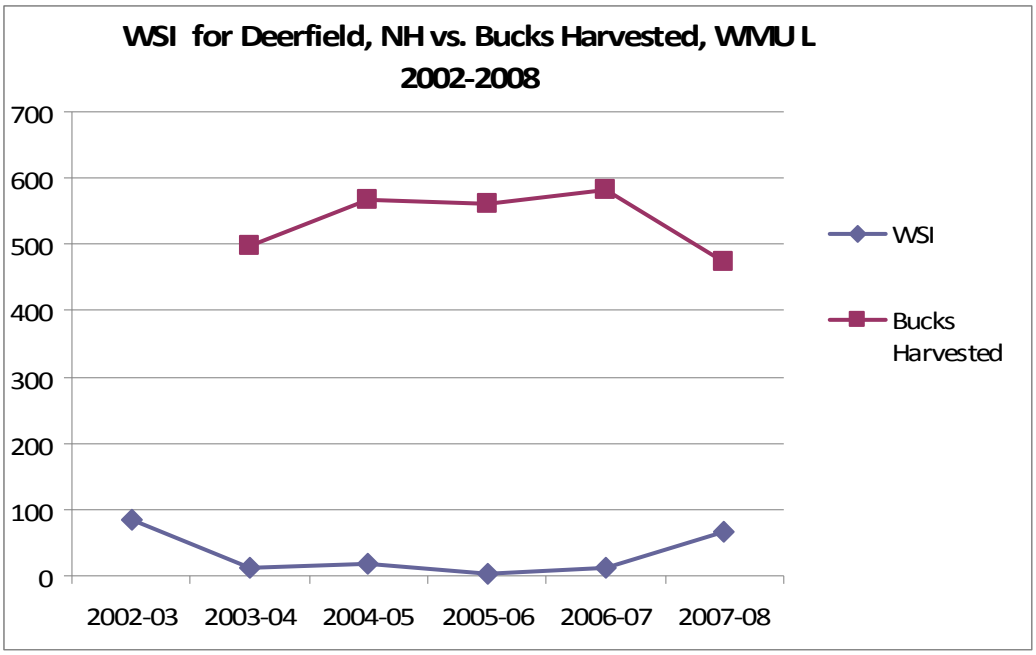
individual series on the same graph (see example). It is recommended that students do not graph every town on one graph, as it will appear cluttered and make analysis difficult.

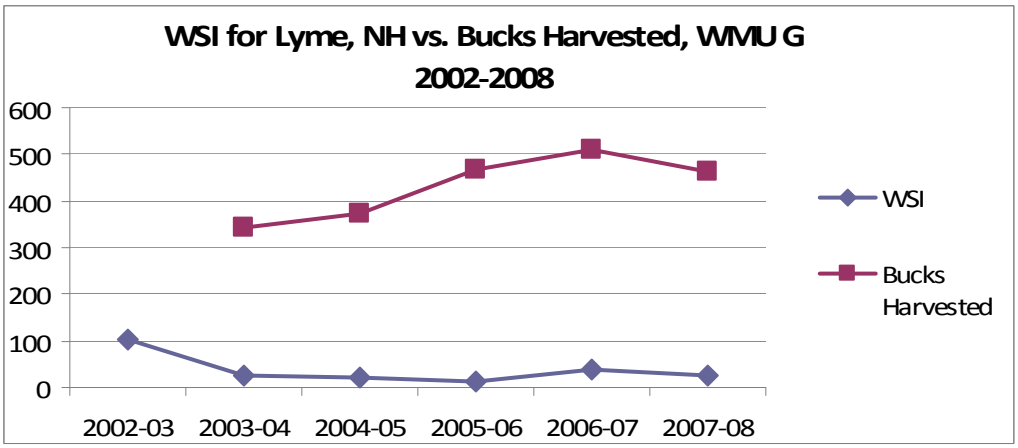
This graph was created using the line graph function in Microsoft Excel. The graph tracks the WSI for five towns from December 2002 through April 2008. A series of data points was created for each town represented by selecting the WSI for the town as the data range and selecting the years 2002-03 through 2007-08 as the X axis data label. The data for each town is graphed as a separate series.



Example 3: These graphs were created using the line graph function in Microsoft Excel. WSI data for a school was selected as the range of data for one series and the number of bucks taken in that school's WMU for each corresponding fall hunting season was selected as another series of data. These sets of data were graphed as series on the same axis with the years from 2002-03 through 2007-08 selected as the x axis data labels.

This allows students to look for correlations between the severity of the winter and the number of bucks harvested (as an indicator of deer population) the following fall. More advanced students may use the formula in the *Notes on Data* section to calculate an estimate of the total deer population in a given WMU and add that information to this graph. Students may also examine habitat in different parts of the state and explore relationships between types of habitat and deer populations.





Acronyms and Definitions

WSI: The Winter Severity Index is a point system that aids wildlife biologists in estimating effects of cold and snowy winter conditions on deer populations.

WMU/WMA: Wildlife Management Units/Areas are sections of the state delineated by differences in climate, topography, land use and human populations.

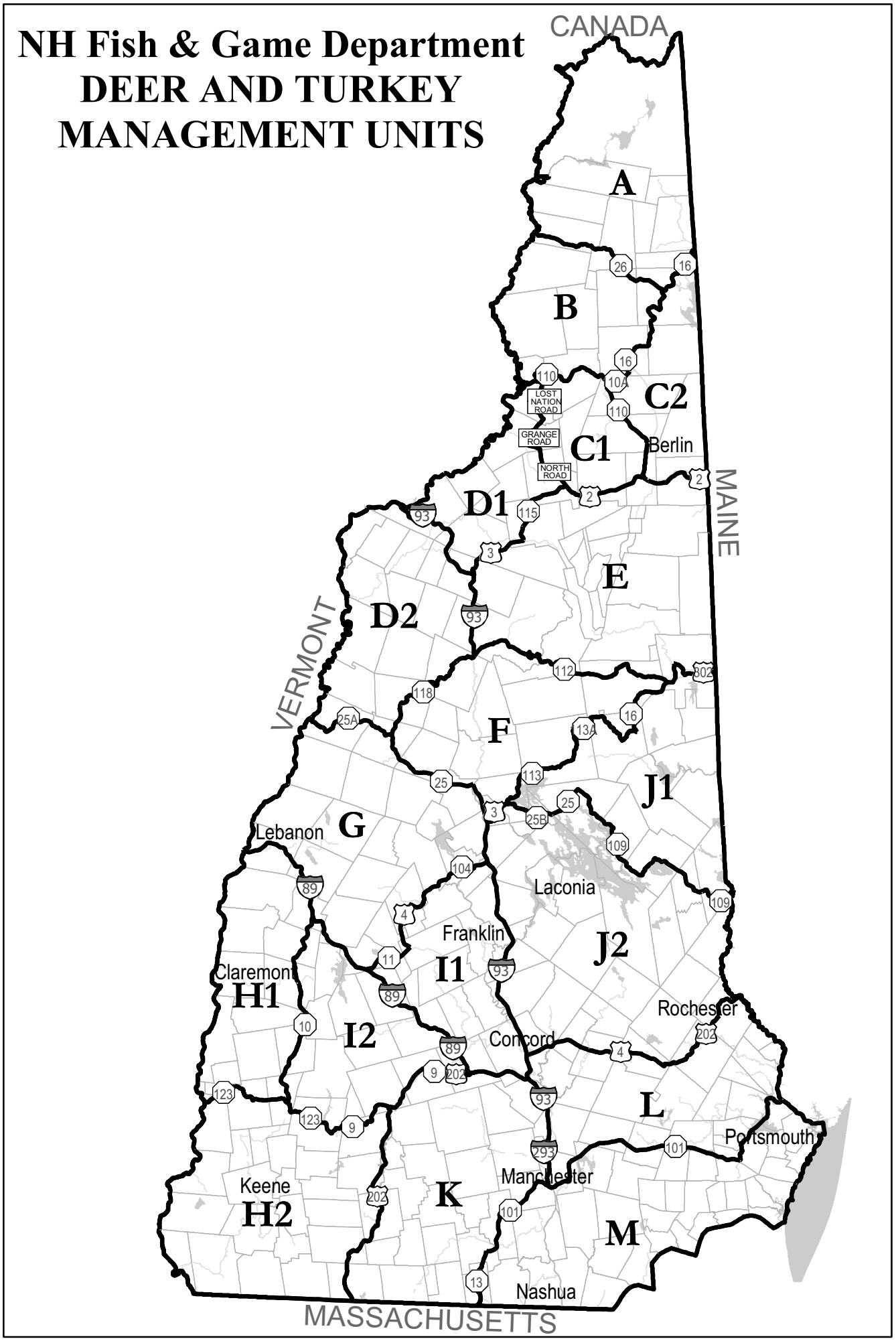
Outlier: An observation in a dataset that is far removed in value from the other data. It is an unusually large or an unusually small value, as compared to the others.

Resources

NH Fish and Game Department, www.wildlife.state.nh.us

NH Fish and Game Podcast/Blog. (The second half of this podcast has information on the Winter Severity Index and deer populations in NH.) http://blog.wildnh.com/tag/deer.

NH Fish & Game Department
DEER AND TURKEY MANAGEMENT UNITS



WINTER, WEATHER, AND WHITE-TAILED DEER

Winter, Weather and White-tailed Deer is a wildlife management curriculum unit designed for middle school students. It provides students with the opportunity of becoming involved in real-life management practices. By measuring daily temperatures and snow depths between December 1 and April 30, students gather crucial data used by N.H. Fish and Game Department staff in determining the annual Winter Severity Index (WSI). The WSI aids wildlife biologists and others in estimating effects of cold winter conditions on New Hampshire deer populations.

WHY INVOLVE STUDENTS: New Hampshire is divided into Wildlife Management Units. Currently, measurements for the WSI are being collected in only a few of these units. By involving students from schools throughout the state, a more specific sampling of data can be collected. Most importantly, students gain experience in data collection and problem solving as applied to a real-life situation. In addition, they learn about a New Hampshire animal species and become involved in promoting its healthy perpetuation. The unit and activities are designed to enhance their wildlife management experience.

WHAT TO DO? Winter severity is measured using a system that involves keeping track of the number of days when the minimum temperature is **less than 0 degrees Fahrenheit** (this constitutes 1 point), **and the number of days where the snow on the ground equals 18" or more** (this also constitutes 1 point). These measurements are taken daily from the school weather station between December 1 and April 30.

WEATHER STATION SET-UP\SNOW STAKE: The snow stake should be located in an area that is protected from strong winds. Ideally, it should be located in a wooded area dominated by hardwoods (deciduous trees...maple, birch, ash, etc.) Make sure the stake is in place at least a couple of weeks prior to the first anticipated snowfall, so you do not have to disturb the area after snow arrives. Also, It will be easier to make sure the stake is all the way down if there is no snow on the ground, and the ground is not frozen. It will be easier on you if the stake is located in an area that is easy to check without having to walk very far. Binoculars may be useful for daily monitoring.

It is most important that the area immediately around the snow stake not be disturbed throughout the winter. A small fence may be required around the area if the stake is located in a high-traffic area or where vandalism may occur. If a fence is constructed, make sure each side is at least 6 feet long, so that the stake itself is no closer than 3 feet from the fence. Fencing material should be 2"x4" or 4"x6" welded wire, with, preferably, steel fence posts.

THERMOMETER: The thermometer should be located on a north or west-facing surface. If the thermometer is attached to a building, it should be at least 12" from any heat-generating surface (window). The thermometer should be checked at about the same time daily, with the minimum recorded. If necessary, be sure to reset the thermometer each day. On days when you can't check the thermometer directly, i.e. weekends, try to look at a thermometer at home or wherever you are and do your best to estimate whether or not the snow depth reaches or exceeds 18". The thermometer should be suspended in the center of the protected area.

WHAT TO DO? Each day from December 1 through April 30, record the number of snow points and the number of temperature points on the data sheets provided.

Send, fax or e-mail your data for the previous month on the first school day of the new month to me at: N.H. Fish and Game, 11 Hazen Drive, Concord, NH 03301; **FAX: 271-5829**; E-mail: mary.goodyear@wildlife.nh.gov.

The information should be sent on the first school day of the month, e.g.. December's figures sent on Jan 4. At times during the winter, I'll share data collected from each of the sites with you. For those who prefer to e-mail or phone the snow and temperature points to me monthly, please send me the completed monthly data sheets at the end of the winter.

Thank you for participating!!

Mary Goodyear
Wildlife Educator
N.H. Fish and Game