

THE GRASS IS ALWAYS GREENER: NITROGEN PROCESSES IN LAWNS AND ADJACENT FOREST LAND IN THE WHITE MOUNTAINS, NEW HAMPSHIRE

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Edna Bailey Sussman Internship Final Report
December 2012

Project Background

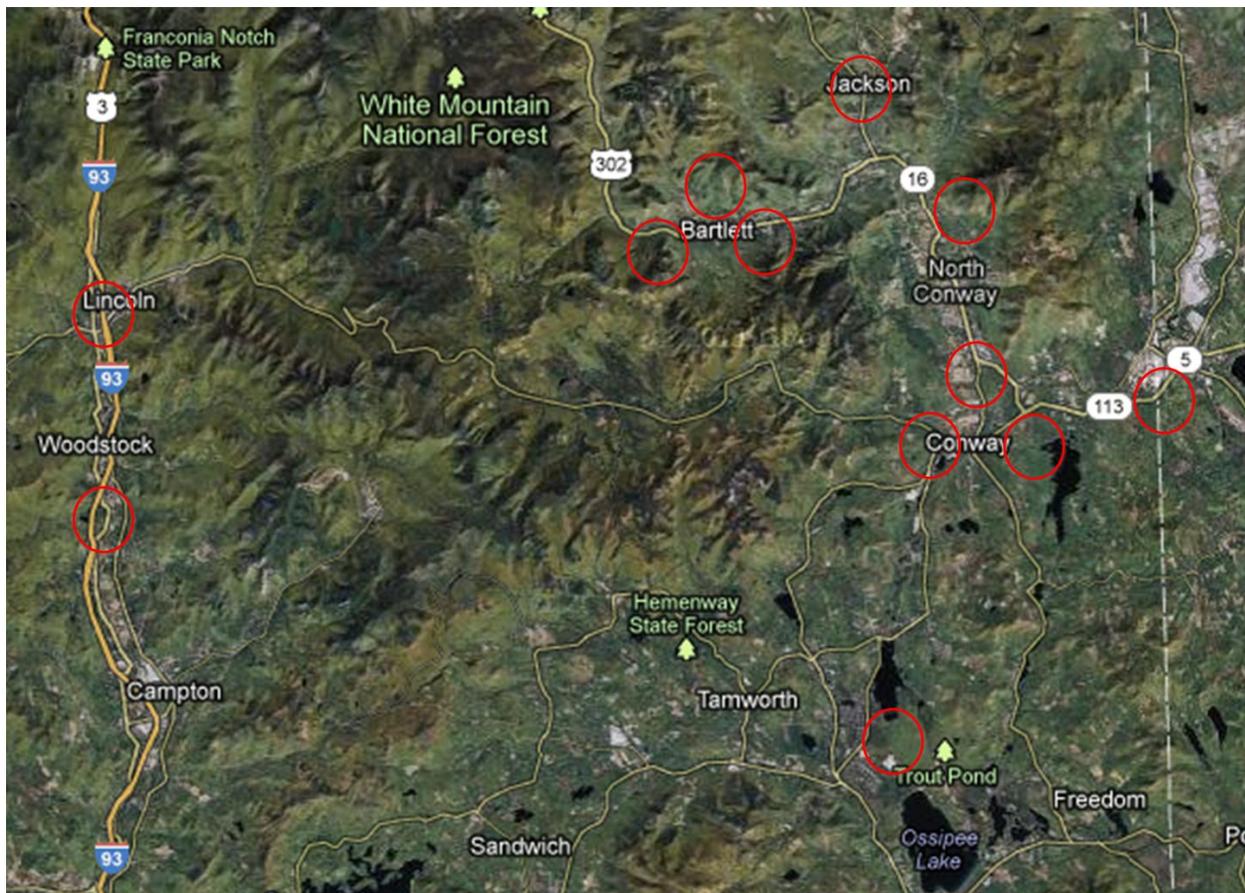
In the past 150 years, it is estimated that global anthropogenic inputs of reactive nitrogen (N) have increased from 15 Tg N annually to over 165 Tg. This increase of available nitrogen to the biosphere has caused a suite of well documented environmental and human health problems. In the Northeastern United States the consequences of nitrogen pollution have included increased ozone formation, the acidification of lakes, and “dead zones” coastal estuaries. Major human sources of nitrogen to the region include wastewater, nitrogen fertilizers, and fossil fuel combustion (Driscoll et al., 2003).

Nitrogen often moves between systems in the form of nitrate (NO_3), which is easily leached from soil and into waterways. For this reason nitrogen retention and transformations have been well studied in Northeastern forests. Of special concern is the microbial process of nitrification, which converts ammonium (NH_4) into more easily leached nitrate. The rapid development of previously forested areas in the Northeast requires that we study these processes in human dominated systems when attempting to make future projections about nitrogen pollution. Due to the increasing number of patches of turfgrass expanding across the national landscape, the biogeochemistry of urban landscapes has become the focus of attention in recent years.

Through my internship with the Cary Institute of Ecosystem Studies, I set out to estimate how nitrogen retention and transformations change as northern hardwood forests are converted into residential lawns. To do this, I randomly selected lawns across the White Mountains of New Hampshire, and compared the nitrification and mineralization rates in each with rates found in adjacent forested lands.

Work Completed to Date

Sampling Scheme: In May 2012, 58 homes (sites) were selected using Google Earth in 12 clusters throughout the region. Within a cluster, streets were identified which contained properties adjacent to one continuous acre of woods. Households on these predetermined streets were selected by going door to door, with a maximum of 2 houses on the same street within a cluster. Once I was granted permission to sample a property, the homeowner was given a survey about their lawn-care practices and the property history.



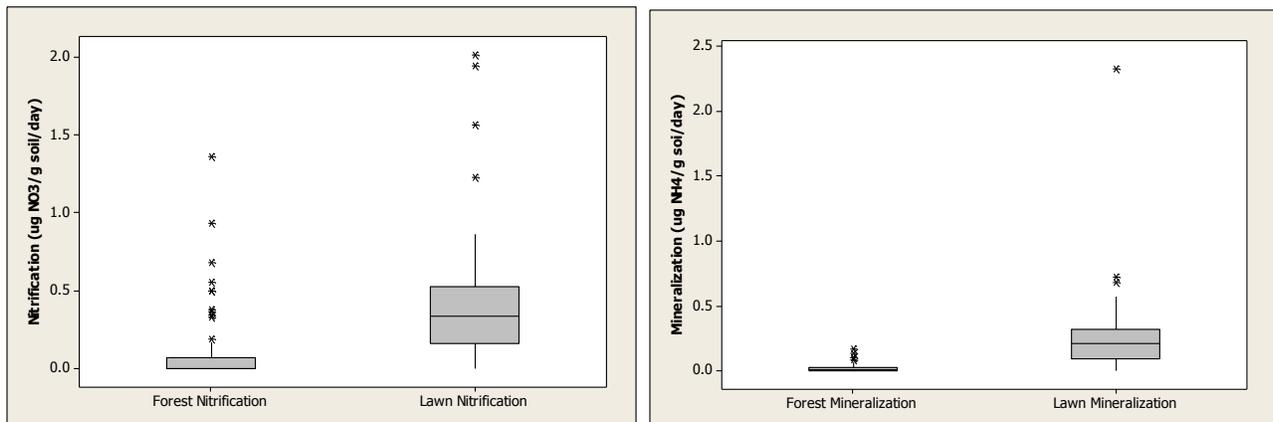
Field Sampling Methods: The boundaries of each lawn sampled were measured using a GPS unit. In each lawn, five 15cm volumetric soil cores were collected, along with five in the adjacent forested lot. For both forest and lawn collections, all five cores were combined and homogenized. In each lawn, cores were taken in five randomly selected locations by subdividing a map of the yard into 16 separate

grid-points. In each forest, a “central core” was taken 30 meters in from the lawn edge, and 4 cores were taken 10 meters in each cardinal direction from this center. A vegetation estimate was made at the location of each lawn core by placing a one square meter grid over each lawn core and recording the percent cover within. In the forested areas, a tree survey was conducted by recording the species and diameter of each tree within 2 meters of the “X” shaped transects created by the four outer cores.



Laboratory Analysis: Three 20 gram subsamples were taken from each soil composite. One subsample was analyzed for NH_4 and NO_3 immediately, and a second subsample was incubated 21 days before performing an identical analysis. The third subsample was dried at 60 degrees and mass loss recorded to estimate soil moisture. Ammonium and nitrate were extracted from the samples using 100ml of 2M KCl. Extract ammonium and nitrate concentrations were determined using an autoanalyzer. The change in total NH_4 over the incubation period was considered net mineralization, while the change in nitrate was considered to be net nitrification.

Preliminary Results and Discussion



The mean rates of both nitrification and mineralization in lawns were higher than in forests ($p < 0.001$).

They were also much more variable. The rates seen in the forested areas was not a good predictor of what was seen in lawns adjacent to them, supporting the idea that human decision-making is controlling the processes of N mineralization and nitrification. The mean rate of lawn nitrification was more than double that of the forest land. Turfgrass systems are able to absorb higher amounts of nitrate, but further research is needed to determine whether this increased vegetation sink is able to absorb this increased microbial source. A preliminary model created using the results of homeowner survey data showed that fertilization practices were the only significant predictor of lawn nitrification rate.

Surprisingly, factors such as watering regimes, pet waste, and soil additions (fillers) do not appear to

play a significant role in controlling these processes. Proportionately, most of the nitrification occurs in the top organic (O) soil layer. I am interested in total amount of nitrate being produced, however, and therefore chose to homogenize my samples across horizons. Because of this, some of the differences in my data likely reflect differing amounts of O horizon soil among sites. I am in the process of getting total carbon and nitrogen data from these samples, which will allow me to express the data as a function of carbon (a proxy for the amount of O horizon present).

Future Research

As mentioned above, I am currently conducting the labwork to get total carbon and nitrogen out of these samples. This will be valuable data in helping shed light on nitrification and mineralization rates which have already been analyzed. When combined with the bulk density estimates, it will also allow for estimates of total nitrogen and carbon storage differences between the lawn and forest pairs.

Finally, I am planning to investigate the land use history of these sites, as past agriculture and forestry practices can have long lasting effects on these processes. I am currently in the process of looking through county tax records to determine the age of each of the lawns in question. This will allow me to estimate the sequestration potential of these land uses over time.

Acknowledgments

I would like to acknowledge my advisor, Ruth Yanai, and Peter Groffman for overseeing my internship with the Cary Institute. A number of scientists gave me comments on my experimental design: Paige Warren (UMass), Melanie Fisk (Miami University), Tim Fahey (Cornell), Paul Lilly (UVM) and Matt Vadeboncoeur (UNH). A number of interns and graduate students associated with the Multiple Element Limitation in Northern Hardwood Ecosystems (MELNHE) project assisted me with my soil sampling and processing: Adam Wild, Russell Auwae, Shinjini Goswami, Clarissa Lyons, and Austin McDonald. Hannah Tremblay, one of the MELNHE interns, was invaluable in the completion of this

project. The Edna Bailey Sussman Foundation has been and will continue to be recognized in all presentations and publications resulting from this research.