REU project proposal: Snail population in response to soil calcium additions

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**Introduction**: Snails require large amounts of calcium (Ca) for shell production and reproduction (Skeldon); however snails cannot take in Ca directly through the soil. Soil Ca is taken up by surrounding trees through their roots, incorporated into their leaves, and fall off in the fall. After the leaves fall, it returns the Ca back to the soil in a form that the snails can eat and in turn, use and incorporate into their shells and eggs. (Raivo, M). A 73% increase in abundance of snails was found in plots that were treated with Ca when compared to a control plot (Skeldon). Snails have been found with greater species richness, abundance, and biomass, in soils that are rich in Ca when compared to Ca poor soils (Boycott 1934; Wareborn 1992; Hotopp 2002). The amount of calcium is partially dependent on the level of acid deposition that a particular area receives; the more acid deposition, the less Ca available (Likens et al. 1996; Driscoll et al. 2001). Acid deposition has become an increasing concern due to the wide range of impacts it can have on a landscape – decreases in soil pH and loss of soil fertility are two factors. Both of these can cause an overall decrease in productivity of the forest (DeForest, J. 2011).

By artificially adding more soil Ca, an overall increase in their numbers are expected due to more snails surviving, growing to maturity, and reproducing. If snail populations are heavily affected by overall soil Ca, they could potentially become a bioindicator species for available calcium in an ecosystem.

This study plans to investigate the effects of soil Ca availability on snail populations in forests that were treated with wollastonite (CaSiO3) at the rate of 1150 kg Ca/ha. The study will also look at the effect that nitrogen (N), phosphorus (P), or N and P together have on snail populations as well. The N, P, and N&P plots were re-fertilized twice a year (May and July). Nitrogen was applied as ammonium nitrate (NH4NO3) at the rate of 30 kg N/ha/yr and P was applied as monosodium phosphate at the rate of 10 kg P/ha/yr.

**Hypothesis:** More individual snails, regardless of species, will be found in plots that have been treated with Ca as compared to control plots. Little research has been done documenting the effects of N or P on snail populations; I expect populations of snails to differ in the N and P addition plots but not enough information is known to predict whether N or P will increase or decrease snail abundance.

**Methods**: Within each forest stand, there are 5 treatment plots. Each plot is either fertilized with N, P, N&P, Ca or no synthetic fertilizer (control). Stands C6, C8, JB (mid-age) and JB (old age) will be sampled. Each plot has posts marking 10 meter intervals, in a 30 x 30 meter grid (Fig, 1). The 12 outer boundary points will be sampled, while the 4 inner points will not be sampled.  Two 8 ½ by 11 inch cardboard sheets will be laid out at 12 points in each plot. This totals to 24 cardboards per plot, 120 per stand, and 480 in total. After it rains (at least a half an inch), the cardboards will become saturated; and as the surrounding leaf litter begins to dry out, the cardboard will remain moist, which provides an ideal habitat for snails. The snails will be attracted to the damp cardboard and attach themselves to the bottom, which we will then collect after the rain. taken; if there are fewer than 20 snails on the first cardboard the second cardboard’s snails will be taken as well. The snails will be kept together based on which cardboard they came from and not mixed with other boards. The snails will be kept in 2 ml microcentrifuge tubes; they will be removed from the cardboard with a pair of tweezers and placed in the pre-labelled tubes. They will be kept together by stand in a plastic Ziploc bag, with 3 groups of 4 taped together (A1, A2, A3, A4 and B1, B4, C1, C4 and D1, D2, D3, D4). Larger, 20 mLvials will be kept on hand as well, in case of larger snails. All cardboards will be collected as close to the same time as possible to negate any time based or drying effects. The time from the end of the rain event to the beginning of collection will be kept consistent between collections if possible.

**Analysis**: The number of snails will be recorded per cardboard, and then each repetition (same cardboard, same spot, different time/rain) will be averaged together. All the cardboards from one fertilizer can be averaged together as well, which can give an overall average and standard error in the number of snails found in each treatment. The overall average in each treatment can then be compared to each other to determine if there is a significant difference between the treatments.

**Expected result:** I expect that there will be significantly more snails found in the Ca plots as compared to all other plots, with a significant –but unknown– difference between the N, P and N&P plots.

**Implications:** If snail populations are affected by the amount of Ca, N and P present in the soil, this could lead to further research to see what other species are affected and what impact it has on the environment. It is possible that arthropods could be affected as well, which could have a cascading effect on any predator that relies on them. Snails could also become an indicator species for low level of soil calcium. Birds also rely on snails during the breeding season for the extra calcium that they need for egg laying. By knowing the effects of calcium on snails, this could also lead into further research about how it affects the local bird population and the survival rate of their eggs/chicks (Hochachka, W. 2001.)

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This is one plot outline, there are 5 plots per stand, and 4 stands being sampled.

 Fig. 1

**References**

Boycott, A.E. 1934. The habitats of land Mollusca in Britain. J. Ecol. 22: 1–38. ….doi:10.2307/2256094.

DeForest, J., & McCart, B. 2011. Diminished Soil Quality in an Old-growth, Mixed Mesophytic …..Forest Following Chronic Acid Deposition.. *Northeastern Naturalist*, *18*, 177-184.

Driscoll, C.T., Lawrence, G.B., Bulger, A.J., Butler, T.J., Cronan, C.S., Eager, C., Lambert, K.F., Likens, G.E., Stoddard, J.L., and Weathers, K.C. 2001. Acid deposition in the northeastern United States: sources and inputs, ecosystem effects, and management strategies. Bioscience, **51**: 180–198. doi:10.1641/0006-3568 (2001)051[0180:ADITNU]2.0.CO;2.

Hochachka, W. 2001. Variations In Calcium Use By Birds During The Breeding Season. *The Condor*, *103*, 592.

Hotopp, K.P. 2002. Land snails and soil calcium in central Appalachian mountain forest. Southeast. Nat. 1: 27–44. doi:10.1656/ 15287092(2002)001[0027:LSASCI]2.0.CO;2.

Likens, G.E., Driscoll, C.T., and Buso, D.C. 1996. Long-term effects of acid rain: response and recovery of a forest ecosystem. Science (Washington, D.C.), **272**: 244–246. doi:10.1126/science. 272.5259.244.

Skeldon, M. Terrestrial gastropod response to an ecosystem-level calcium manipulation.in a …northern hardwood forest.

Raivo, M., & Vallo, T. Calcium, snails, and birds: a case study. *Web Ecology*, *1*, 63.

Wareborn, I. 1992. Changes in the land mollusk fauna and soil chemistry in an inland  district in southern Sweden. Ecography, 15: 62–69. doi:10.1111/j.1600-0587.1992.tb00009.x.