

Hemlock Woolly Adelgid's Influence on Bird Populations

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Background

Eastern Hemlocks (*Tsuga canadensis*) range from Minnesota down to Alabama, all the way to the East Coast. In the 1950's an invasive aphid, Hemlock Woolly Adelgid (*Adelges tsugae*) (HWA), was brought to Virginia from Japan. Since its arrival, the species has infested 20 US States (Marshall, M.) and spreads at a rate of ~8km per year. HWA feeds on the parenchyma cells of the Hemlocks xylem (Becker, D.). The aphid secretes a wax that has a wool like appearance that is about 1/8 inch thick, where the adults lay their eggs (Bohne, M.) (Figure 4). HWA begins by defoliating the lower limbs as it feeds on needles and buds. Eventually the infestation will make its way up the tree leading to mortality in as little as 4 years (Marshall, M.) and 85% suffer mortality within 7 years (Brown, D.).

Hemlock trees provide a unique habitat for birds as they are shade tolerant, leading to dense mid and understories. This creates a large vertical habitat for birds to nest and forage. Species such as Black throated Green Warbler (*Setophaga virens*) (Figure 3), Acadian Flycatcher (*Empidonax virens*), and Blackburnian Warbler (*Setophaga fusca*) depend on Hemlocks (Field, R.). Birds have specialized niches to Hemlocks and the loss of their habitat can be drastic. Black throated Green Warblers experience a 93% decline when Hemlock stands die (John, K.). Other bird populations, such as Eastern Wood Pewee (*Contopus virens*) and Wood Thrush (*Hylocichla mustelina*), thrive in the canopy gaps and dead ...trees in result of HWA (Becker, D.).

As Hemlock Woolly Adelgid spreads to the remainder of the US it will be vital to know how bird populations are going to be affected. Species that are dependent on Eastern Hemlock could possibly go extinct as they lose habitat.

Hypothesis

There is a relationship between Eastern Hemlock trees infested with Hemlock Woolly Adelgid and the number of bird species present.

Prediction

Species that are Hemlock dependent, such as Black Throated Green Warbler and Acadian Flycatcher will decrease in numbers as infestation occurs. Generalist species will initially increase as canopy gaps appear creating openings for birds. However as time goes on and the trees decay, the bird community will decline overall.

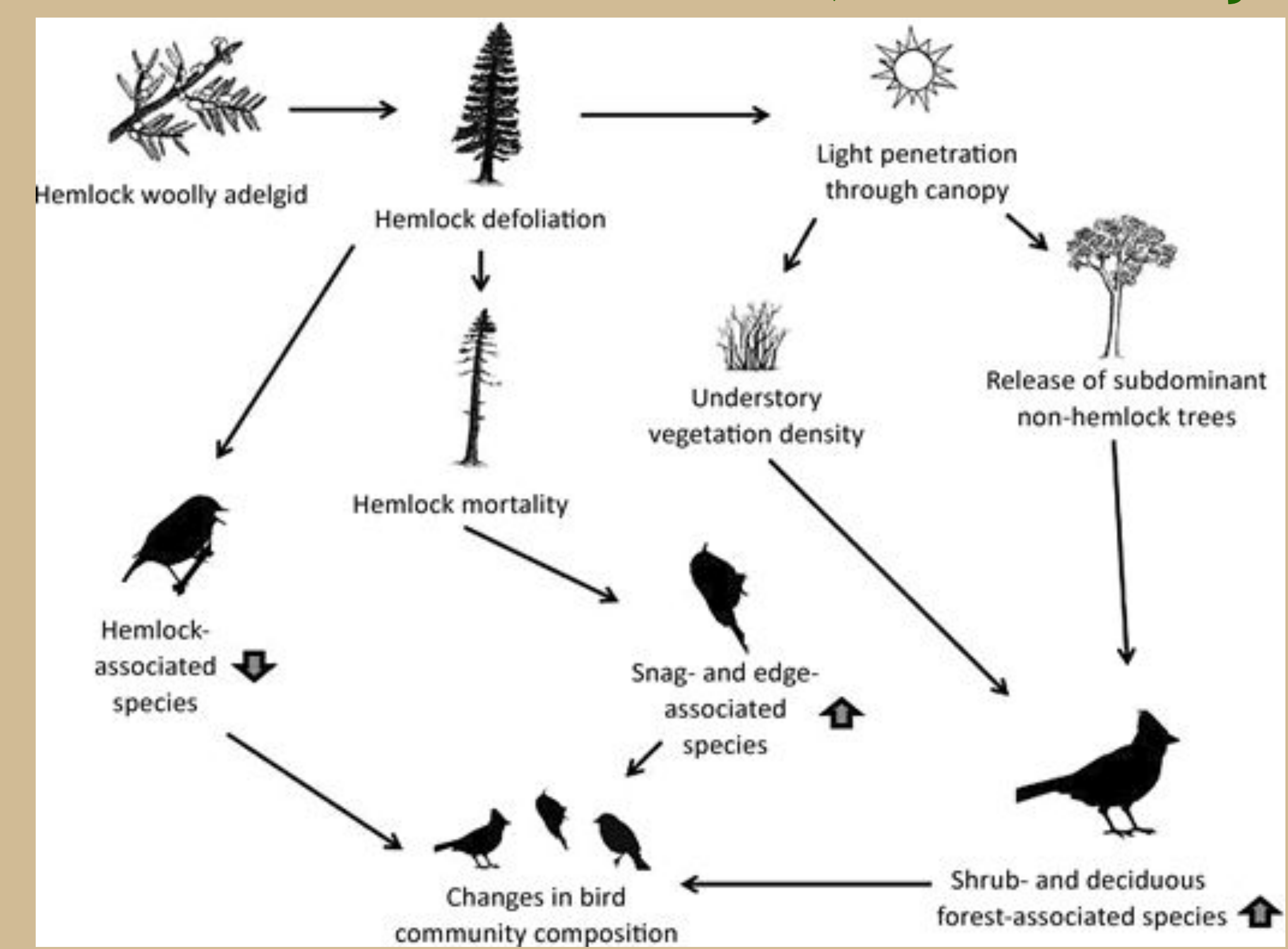


Figure 1. Influence of HWA on a community from The Condor.

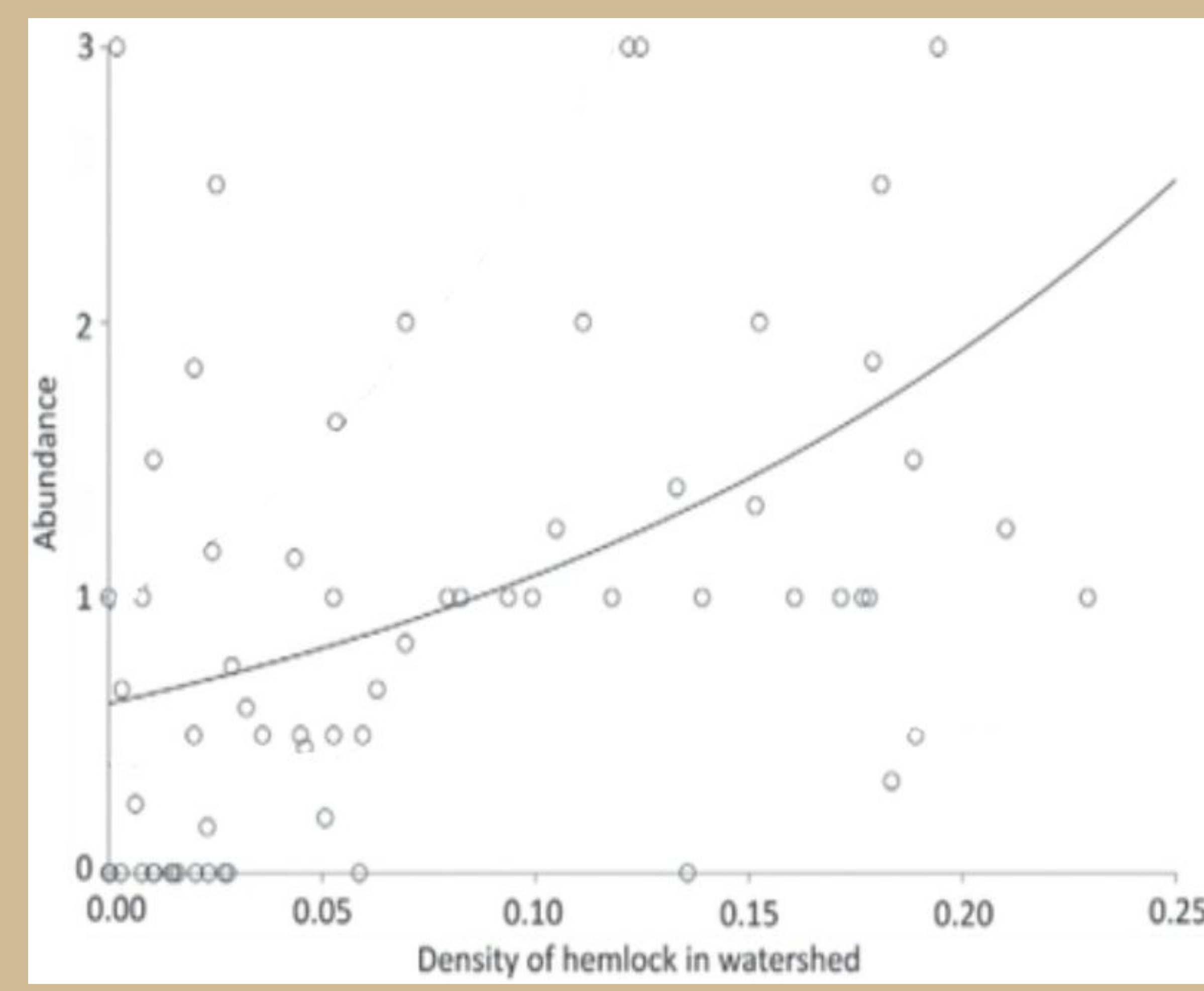


Figure 2. Abundance of Black throated Green Warbler as the density of Eastern Hemlock increases from Southeastern Naturalist.



Figure 3. Black throated Green Warbler from John, K.

Study Design

An observational study will be conducted to survey the different species present in Eastern Hemlock trees. Hemlock groves of two neighboring towns, Pownal and Stamford Vermont, will be surveyed. Pownal has reported sightings of woolly adelgid, but Stamford does not yet have any. Both towns have similar elevation which would allow for the same types of birds to be present in each location. There will be 2 hemlock stands surveyed in each town to ensure repetition, Pownal will have infested trees while Stamford will not, marked in Figure 5. Groups of birders will go and survey the species present in each location in the spring and in the fall in order to count species during breeding and migration.



Figure 4. Wool secreted from Hemlock Woolly Adelgid. Photo from USDA Forest Service.

Intended Analysis

The independent variable in this study is categorical, healthy Hemlocks and infested Hemlocks. The dependent response variable will be the number of bird species present in each stand of trees, which will be continuous. The data collected will be analyzed using a T test. The test will depict if there is a decrease in the number of bird species present in infested trees. The scope of inference is limited by location. There are many other factors that may influence bird species, such as proximity to water, but by picking two towns next to each other we are trying to limit the differences between the two.

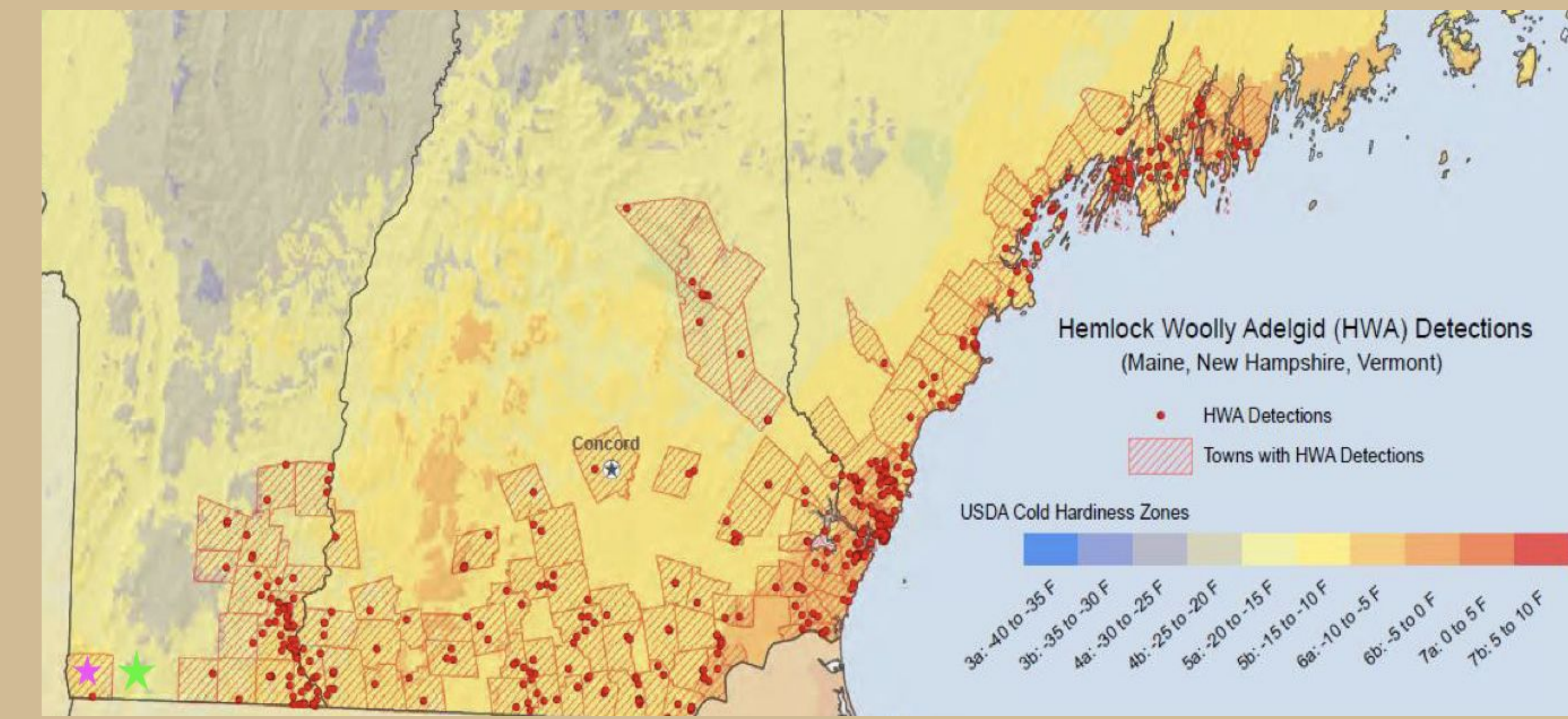


Figure 5. HWA sighting in VT, NH, and Maine. Pownal is marked with a pink star and Stamford with the green star. From USDA Forest Service.

Literature cited: Becker, D., Brittingham, M., & Goguen, C. (2008). Effects of Hemlock Woolly Adelgid on Breeding Birds at Fort Indiantown Gap, Pennsylvania. *Northeastern Naturalist*, 15(2), 227-240. <http://www.jstor.org/stable/25177102> Bohne, M., Esden, J., Hanavan, R., Lombard, K., Kanoti, A., & Schultz, B., Weimer, J. Managing Hemlock in Northern New England Forests Threatened by Hemlock Woolly Adelgid and Elongate Hemlock Scale. *USDA Forest Service, University of New Hampshire*, 1-3, 11. https://extension.unh.edu/resources/files/Resource005573_Rep7772.pdf Brown, D., & Weinkam, T. (2014). Predicting Bird Community Changes to Invasion of Hemlock Woolly Adelgid in Kentucky. *Southeastern Naturalist*, 13, 104-116. <http://www.jstor.org/stable/26454960> Field, R., Motzkin, G., Orwig, D., & Tingley, M. (2002). Avian Response to Removal of a Forest Dominant: Consequences of Hemlock Woolly Adelgid Infestations. *Journal of Biogeography*, 29(10/11), 1505-1516. <http://www.jstor.org/stable/827565> John, K. S. (2014). The Link between Hemlocks and Birds. *Outside My Window*. <https://www.birdsoutsidemymywindow.org/2014/12/03/the-link-between-hemlocks-and-birds> Marshall, M. R., Miller, D. A. W., Toenies, M. J., & Stauffer, G. E. (2018). Shifts in vegetation and avian community structure following the decline of a foundational forest species, the eastern hemlock. *The Condor*, Volume 120, Issue 3, Pages 489-506. <https://doi.org/10.1650/CONDOR-17-204.1>