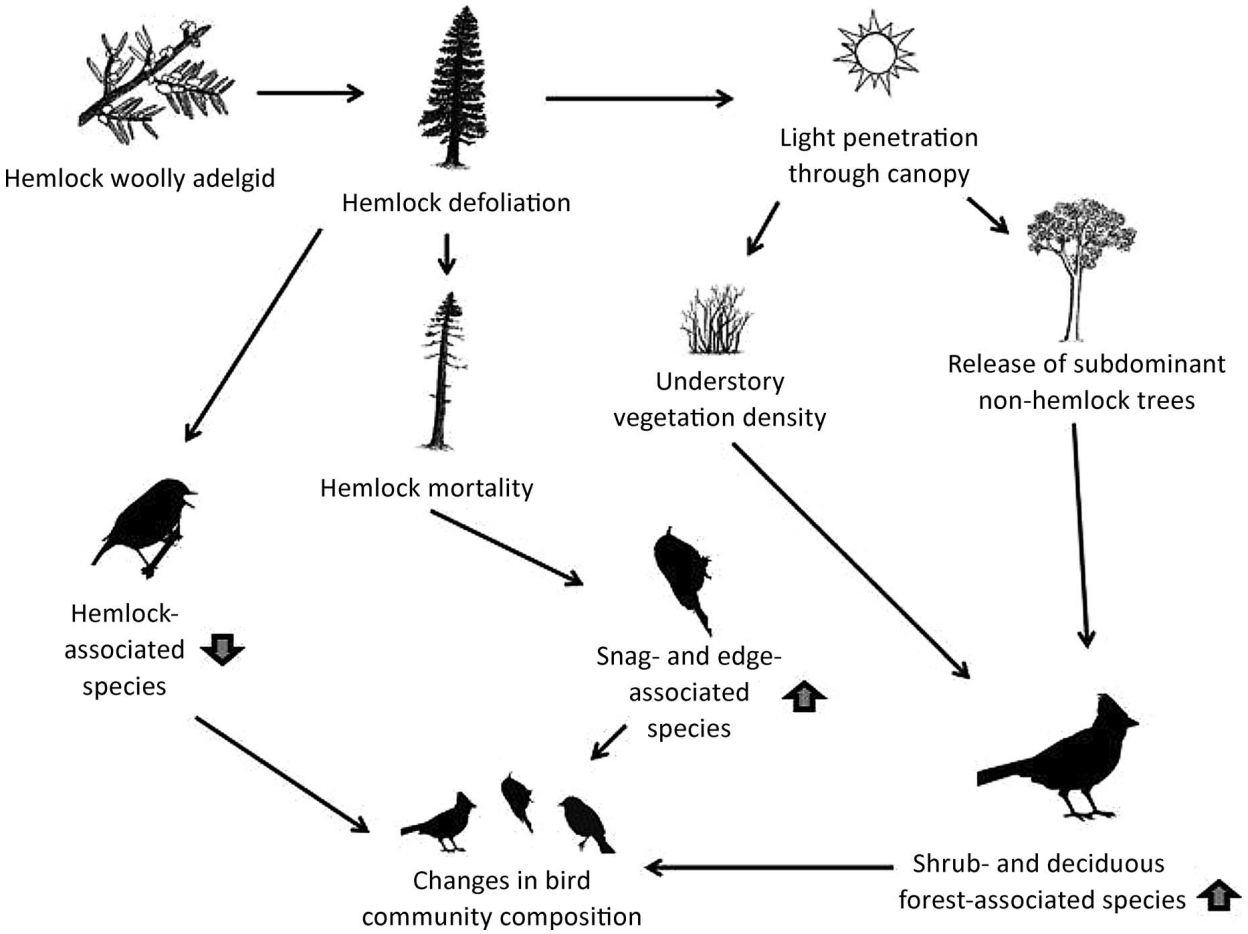
What do the results of the hemlock surveys tell us?

I want to share some of my thoughts on the results of last year's hemlock breeding bird surveys. There are people on this mailing list who know much more about forest birds than I and more about forestry in general. But I think there are some puzzling aspects of the results and I hope we might have some group discussion about them.

So this is what I see. First, certain bird species are strongly associated with mature hemlock stands. These species are the Black-throated Green Warbler, Blackburnian Warbler, Blue-headed Vireo, and Hermit Thrush. Some ornithologists consider these species as "obligate" hemlock species as they evolved with hemlocks and could have difficulty adapting to other environments in the Acadian forest. Others species in our top ten list are birds of the deciduous forest. The top two species, Ovenbird and Red-eyed Vireo (tied with Black-throated Green Warbler for second place) are birds of mature deciduous or mixed woodlands. The same is true of the 5th and 6th most abundant species, Black-capped Chickadee and Northern Parula. This discussion will focus on the Red-eyed Vireo, which prefers forests with openings in the canopy that create a dense understory. The figure below demonstrates a hypothetical process of changes in bird populations due to gaps in the canopy made by hemlock dieoff from the Hemlock Woolly Adelgid.



This diagram is taken from Toenies et al, 2018, "Shifts in vegetation and avian community structure following the decline of a foundational forest species, the eastern hemlock," *Ornithological Applications,*120: 489-506. This paper demonstrates fundamental changes in the bird species composition towards the increasing abundance of deciduous forest birds as the infestation advances. The authors refer to this process as the degradation of hemlock stands.

In an earlier paper, Tingley, et al., 2002, "Avian response to removal of a forest dominant: consequences of hemlock woolly adelgid infestations," *Journal of Biogeography,* 29: 1505-1516, give the mean number of birds by species in hemlock stands in various stages of degradation in southern New England. The authors found, using point counts, the mean number of 1.54 Black-throated Green Warblers and 0.13 Red-eyed Vireos in an intact hemlock stand within the 50-meter band. As the infestation advanced, these numbers changed to 0.5, 0.3, 0.1 for BTNW, and 0.31, 0.40, and 0.50 for REVI. In our 2020 results, the mean number of BTNW was 1.31 and 1.69 for REVI (based solely on visit #1).

While a few of our hemlock stands show signs that infestation has started, none that I know of have experienced mortality from the HWA.

So the question I am asking is, "were hemlock stands degraded before the HWA, and if so, what is the cause?" Possible factors could include harmful forest practices, climate change, lack of forest connectivity, and invasive species. Toenies notes that this kind of forest "homogenization" is occurring on a global scale.

However, it is premature to jump to any conclusions. Our sample size is small. We need to do some vegetative surveys in our hemlock stands to see if the understory vegetation has increased in density. We must be sure that we are not misidentifying Blue-headed Vireos as Red-eyed Vireos. We must hone our skills in estimating distances.

For me, these results call to mind the seminal study of Robert MacArthur in Acadia National Park in Maine in 1956, just across from Yarmouth County. This study established MacArthur as one of the founding figures in the then-new field of ecology and established the concept of ecological niche. He demonstrated that five species of warblers, the Cape May Warbler, the Bay-breasted Warbler, the Blackburnian Warbler, the Black-throated Green Warbler, and the Yellow-rumped Warbler foraged in different parts of each tree, avoiding competition with each other. Sixty years later, a graduate student, Bik Wheeler, tried to replicate MacArthur's study. He found that the Cape May Warbler, the Bay-breasted Warbler, and the Blackburnian Warbler no longer nested in this forest. Instead, he found the Magnolia Warbler, American Redstart, Black-and-White Warbler, and Common Yellowthroat. These are species that prefer smaller coniferous trees (Magnolia), mixed and deciduous forests (American Redstart and Black-and-White Warbler, and brushy habitats (Common Yellowthroat). Thus, even in a protected National Park, there seems to have been this process of forest homogenization. Here in Nova Scotia's Acadian forest, the Cape May Warbler has largely disappeared, and the Bay-breasted Warbler is scarce.

Are the Black-throated Green Warbler, Blackburnian Warbler, and Blue-headed Vireo under threat of similar declines? It is important to note that in my studies of nocturnal migration, the Bay-breasted Warbler and Cape May Warbler have been very common in recent years, probably because of the spruce budworm outbreak in the eastern boreal forest. These two species explode in numbers during spruce budworm outbreaks.

How much are the changes that we see in the Acadian forest is due to spruce budworm cycles, invasive species, forestry, or the shifting of coniferous dependent bird species northward due to climate change?

John Kearney, 25 May 2021

Comments by Nancy Dowd

I find Blackburnian, Black-throated Green Warblers and Blue-headed Vireos in a variety of habitats so, on a positive note, they are adaptable. But this says nothing about whether populations are declining relative to those species who prefer the more homogenized forest structure.

Since sampling largely relies on detection by sound in the tall hemlocks wonder if Bay-breasted and Cape May Warblers (and possibly Blackburnian) go uncounted based on their high frequency songs- not audible to all ears and these high-pitched sounds attenuate rapidly with distance preventing AudioMoth pickup as well.

I find most hemlock stands in my area are remnants, often found on the west sides of lakes and rivers "protected" by cottages and bordering roads/trails. Often the other side of the property is a totally different forest (mixed or hardwood dominant) so definitely forest homogenization happening as discussed. On the plus side these small stands might be less susceptible to HWA infestation. An argument for only logging birds picked up in the nearest distance category in my case.

Additional Comments

Thank you for your comments, Nancy! I especially think that our ability to hear high-frequency songs in a hemlock stand is an important warning that you make. I hope our analysis of recordings will give us more insight into this.

Two other participants wrote to me directly. One noted that what some call the hemlock specialists are pretty widespread throughout the Acadian Forest. Another indicated that Red-eyed Vireos are so abundant they attend to spill over into every forest habitat. He also reminded us that some hemlock species like Blue-headed Vireo and Yellow-rumped Warblers are early nesters and may be singing much less when we do our surveys.