Community-Based Monitoring in the Catskills

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Abstract

The Olive Natural Heritage Society, Inc. (ONHS) is a not-for-profit association devoted to community conservation in the Catskill region of New York State. Members are advanced amateur and professional scientists who carry out a range of environmental monitoring activities. The hemlock forests in the Catskills are threatened by the hemlock woolly adelgid (HWA). The ONHS has completed a preliminary survey of HWA activity at quarter-mile intervals along all roads in each sub-basin of the Esopus Watershed, the principal source of water for the Ashokan Reservoir, the largest component of the New York City-Catskill water supply. The ONHS also is monitoring the status of HWA infestation in the forest surrounding the release site of predatory beetles. The ONHS is monitoring the ectomycorrhizal fungi associated with hemlock, and has begun an inventory of all multicellular organisms in a first growth hemlock forest.

Keywords:

Hemlock woolly adelgid, community monitoring, New York City watershed, Catskill Mountains, multicellular organism survey.

Introduction

The Olive Natural Heritage Society (ONHS), a regional center to integrate field biology with its companion natural, social, and information sciences, has accepted the challenge to understand the Catskill region's biological diversity in all its complexity in order to preserve it in a sustainable fashion (Bierhorst 1995; Adams 2001). This knowledge is critical if society is to maintain the region's natural resources, grow its economy, sustain human health, and improve the quality of life. This mission becomes ever more urgent as natural landscapes are converted to human-managed systems followed by declining biological diversity, disrupted natural ecological processes, and even changing climate patterns.

Prior to European settlement of the Catskills, in the 17th and 18th centuries, the eastern hemlock (*Tsuga canadensis*) was a common species of the lowland forest. Hemlock forests never

dominated the slopes above 3,000 feet, which for the most part were covered with a northern hardwood forest of sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), and black cherry (*Prunus serotina*). In the Catskills today, hemlocks are mainly restricted to gorges, ravines, and swamps where the shade-tolerant hemlock grows best. Hemlock forests growing on well-drained uplands with flat or moderate slope were cleared for cultivation or pastures. Since the abandonment of many of these old farms in the early 20th century, mixed hardwood conifer secondary forest has returned.

The Catskills were the center of an international industry of tanning animal hides after the War of 1812. Hides came mainly from Argentina via the West Indies by boat up the Hudson River to docks at Rondout and Catskill. Hemlock bark was the foundation of the industry until chemical tanning eliminated the need for bark after 1900. In the tannery, tannins were leached from ground bark. Hides were softened in water and pounded, and hair and fat were removed by hand before the hides were immersed in tanning solution for six weeks. The industry peaked in the mid-1800s and was gone by the turn of the 20th century. The tanning industry removed much of the first growth hemlock left after clearing for agriculture, but some remnants remain[1]. Kudish (2000) has identified at least sixteen groves of first-growth eastern hemlock in the Catskills. Most first growth forests are at high elevations in sites remote from historical tanneries.

Monitoring Esopus Watershed for Hemlock Woolly Adelgid (Adelges tsugae). The HWA entered the Hudson Valley in the 1980s and the leading edge of the infestation has moved northward at the rate of approximately 12 miles a year. The leading edge presently cuts through the Catskill counties of Ulster, Sullivan, Greene, and most recently Delaware. Initially the infestation seemed to be confined to the lower valleys, but has invaded headwater forests in recent years. Although it is assumed that infested trees will die within 10 years, there is hope that the remnant first growth groves may be spared by their isolation and the colder conditions at their high elevation sites. The HWA is known to be spread by wind, birds, and mammals and by human activity as our survey results demonstrate.

The ONHS hosted a forum in 1998 to discuss forest management problems in the New York City-Catskill watershed. At this meeting, representatives of the USDA Forest Service (USDA-FS), New York City Department of Environmental Protection, and the New York State Department of Environmental Conservation (NYS-DEC), joined local forestry and environmental groups. Out of the discussions came the recognition that the eastern hemlock was a keystone species important to the functional integrity of headwater streams in the watershed. It was apparent that the HWA was becoming a serious threat to the regional forest health. As a follow up to that meeting, a NYS-DEC forest entomologist conducted a workshop for forest landowners at the ONHS laboratory. He provided training in recognition and quantification of HWA infestation and encouraged the ONHS to develop a community-based program to focus attention on the importance and threats to the hemlock in the Catskills. He also found funding for two summer interns. In the summer of 2000, we made a preliminary assessment of the HWA presence in the Esopus watershed and developed

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[1]The destruction of the hemlock forest in the Catskills by bark peelers is legendary. It is said that the region's famous trout streams ran red with sediment and were totally dead.

detailed sub basin maps in our Geographic Information System (GIS). The Esopus watershed is the principal source of water for the Ashokan Reservoir, the largest component of the New York City-Catskill water supply. The interns also began detailed studies of the food web and ectomycorrhizal fungal community associated with the hemlock forest.

In the summer of 2001, we completed a detailed survey of HWA activity in the Esopus watershed above the Ashokan Reservoir. Access to forests immediately surrounding the reservoir is restricted. Student interns drove slowly along all roads in each sub-basin. At one-quarter mile intervals they stopped to obtain a GPS reading and to record the following data: presence/absence of hemlock and the adelgid density coded (0 = no adelgid activity; 1 = light infestation; 2 = moderate infestation; 3 = severe infection; and 4 = tree dead). Two observers confirmed all data and several routes were resurveyed for quality control purposes. All data and metadata were entered into Arc View 8.0 GIS.

A close look at selected sub basins allowed us to examine the HWA infestation at different stages. In the headwaters, low density adelgid (early infestation) is present in only two sites. Both, however, are significant due to the presence of unusual human activity. One is at the driveway to a resort and restaurant and the other is at the entrance to a populated area. Along this segment of the stream there are few other concentrations of human activity. Most of the land bordering the stream is in the Catskill Forest Preserve. There are no nearby HWA infestations and we observed no bird feeder activity at any of the seasonal cabins along the road. At least in the Catskills it appears that human activity is closely associated with early infestation distant from other infestations.

In Woodland Valley, a populated tributary of the Esopus, the infestation is advanced. We know from earlier surveys that early infestation was present at least three years previously. Woodland Valley is the site of a public campground, and at that site we could find no hemlocks that were not severely infested or dead. There was another nexus of severe infestation on one of the spur roads. This site is somewhat built up with year-round residences. The core of the valley has an early infestation, which may have spread from either or both of the severe infestations by wind dispersion or from birds visiting feeding stations. Here a combination of human activity and natural dispersal may account for the observed conditions.

Finally, along the Esopus main stem the density of hemlock is very low and although there is intense human activity, the hemlock trees are widely dispersed. Apparently, isolated trees are not yet infested. However, we found several severely impacted or dead trees that would indicate that the infestation had been present for at least three or four years and perhaps longer.

During the surveys, landowners who inquired about the survey were eager to learn what was happening to their hemlocks frequently approached the students. The students identified themselves as students at the local community college who were doing a summer internship with a local environmental organization. They took the opportunity to demonstrate the pest and explain homeowner options for treatment of specimen trees on their properties. The students also instructed the homeowners to contact Cornell Cooperative Extension offices for more information. ONHS has been interviewed by the local press and has distributed our survey results to regional forestry organizations and recipients of our newsletter.

Fine Scale Survey of Predatory Beetle Release Site. The ONHS participated in the release by the NYS-DEC of 2,500 *Pseudoscymnus tsugae* on June 1, 2000, at a site in West Shokan, New York. This site was chosen for testing the utility of the predator beetles in combating early infestations of HWA. During the summer of 2000, we monitored the release tree and several surrounding hemlocks affected with the HWA. The predator beetles seemed to be doing well. However, during the 2001 field season we were unable to find beetles. We have consulted with a USDA-FS forest entomologist, who has advised us on recommended techniques for doing fine-scale monitoring of the infestation near the release site. Starting at the release site, we have laid out a grid at 100-meter intervals on a digital orthoimage, to define 25 data points at the nodes. In October 2002, at each data point, (located with hand held GPS unit), we will record : hemlock stand density, history of the site, adelgid density, and the presence of other hemlock pests (e.g., spider mites and scale insects).

Ectomycorrhizal Fungal Community in First Growth Hemlock Forest. Ectomycorrhizal fungi (EMF) play a central role in tree nutrition and carbon cycling, supplying necessary soil minerals and nutrients to their hosts in exchange for sugars. European observers have noted a decline in sporocarp number in response to nitrogen fertilization and atmospheric nitrogen deposition (Arnolds 1991; Shafer and Schoeneberger 1994). A significant rise in nitrates in Catskill streams has been documented (Lovett et al. 2001).

In 2000, ONHS began to obtain baseline and time-series data on composition and abundance of ectomycorrhizal macrofungi in groves of first-growth hemlock growing along rocky headwater streams in the New York City-Catskill Watershed. Primary emphasis of this study is to quantify the productivity and relative dominance of species of macrofungi known or suspected to form ectomycorrhizae.

In 2001 we refined our survey by applying a protocol modified from Mathiasen and Albion (2001). Four 0.1 ha (17.9 m radius) circular plots were established along a transect at each site and all sporocarps were collected at approximately 2-week intervals in the prime fruiting season. Voucher specimens were dehydrated before storage. All information was stored in a computerized database. The total extent of the stand was delineated on the digital ortho-image and the areal extent calculated. The following summary lists the species of macrofungi consistently collected on the study plots.

AMANITACEAE
Amanita virosa
Amanita vaginata
Amanita porphyria

BOLETACEAE
Boletus subtomentosus

CORTINARIACEAE
Cortinarius alboviolaceous "group," perhaps *C. malachius*, which favors conifers and is one of a group of species with violet- to pale-lilac pigments.

Cortinarius paleiferus

Cortinarius scaurus "group." A common species in this hemlock forest, it is one of the most important members of the fungal community. The precise species is difficult to determine and it may be undescribed.

RUSSULACEAE

Russula sanguinea. This is the most common and consistent *Russula* under hemlocks. There is some confusion regarding the proper name; *R. rosacea* may be a synonym.

Russula laurocerasi. This species is a member of the *R. fragrantissima* "group" that grows under conifers.

Russula brunneola

Lactarius lignyotus

Lactarius oculatus. This species often is the most common species under eastern hemlock.

Lactarius affinis

We recognize that sporocarp production is not a direct measurement of the underground EMF community. For example, we have identified *Cenococcum geophilum* as the primary ectomycorrhizal fungus of hemlock in the Catskills. This species is an imperfect fungus that like many important EMF species does not have conspicuous above-ground sporocarps. Fruiting may be influenced by many factors including moisture and temperature. Furthermore, morphological identification techniques do not permit identification of many fungal symbionts and often lead to false lumping and splitting of taxa (Lilleskov et al. 2001). Molecular methods have been used to identify EMF. ONHS is presently developing the laboratory capacity to do definitive molecular identification.

Survey of Multicellular Organisms of First Growth Hemlock Community

The imminent threat of the HWA to the hemlock forest of the Catskills adds urgency to the ONHS efforts to document the complete range of multicellular life in the first-growth hemlock forest. We may have five or fewer years to complete this endeavor before the last remnant groves are impacted. Of course, it will not be possible to complete a definitive catalog of every organism that makes up this complex community. However, salvage collecting is underway and it is our goal to complete at least a first pass in the next 5 years.

In summary, we hope we have demonstrated that community monitoring can be an important component in planning and implementation of a response to the HWA infestation.

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References

Adams, M.S. (ed). 2001. *Catskill Ecosystem Health.* Purple Mountain Press, Fleischmanns, New York.

Arnolds, E. 2001. Decline of ectomycorrhizal fungi in Europe. *Agricultural Ecosystems Environment* 35: 209-244.

Bierhorst, J. 1995. *The Ashokan Catskills: A Natural History*. Purple Mountain Press, Fleischmanns, New York.

Kudish, M. 2000. *The Catskill Forest: A History*. Purple Mountain Press, Fleischmanns, New York.

Lilleskov, E.A., T.J. Fahey, T.R. Horton, and G.M. Lovett. 2001. Belowground ectomycorrhizal fungal community change over a nitrogen deposition gradient in Alaska. *Ecology,* 83(1): 104-115.

Lovett, G. M., K.C. Weathers, and M.A. Arthur. 2001. Is Nitrate in Stream Water an Indicator of Forest Ecosystem Health in the Catskills? pp. 23-30. In Adams, M. S. (ed.). *Catskill Ecosystem Health.* Purple Mountain Press, Fleischmanns, New York.

Mathiasen, R. L. and C. S. Albion. 2001. Sporocarp production of ectomycorrhiza associated with ponderosa pine in four stand types in northern Arizona. *Harvard Papers in Botany* 6(1): 147-154.

Shafer, S. R. and M.M. Schoeneberger. 1994. Air Pollution and Ecosystem Health: The Mycorrhizal Connection, pp. 153-187. In Pfleger, F. L. and R.G. Linderman (eds.). *Mycorrhizae and Plant Health.* American Phytopathological Society Press, St. Paul, Minnesota.