

15 December 2007

Project: Genetic and Morphological Diversity in Carolina Hemlock Populations**Granting Agency:** National Park Service, Appalachian Highlands Network Researcher Assistance Stipend, \$2000**Principle Investigator:** Foster Levy, Ph.D., East Tennessee State University**Other Personnel:** Ke Chen, Ph.D.
Chris Liu, Ph.D.
Tim McDowell, Ph.D.
Jordan Baker, Graduate Student (M.S.)
Whitney Million, Undergraduate Student
Graham Cooke, Undergraduate Student**A. Report of Findings****Objective 1:** Census and map four populations of Carolina hemlock**Status:** Completed. Four populations were censused. A transect of 100 - 200 meters was established and approximately 100-400 hemlock individuals were mapped in each population. The point locations for the transect and each individual were transferred to a GIS mapping system to produce accurate maps for each population. Photos were taken in three of the populations. See detailed "Census" report, attached.**Expenses:** Travel; Spotting Scope**Objective #2:** Test spread hypotheses using cluster analysis**Status:** Completed. Cluster analysis was implemented for each population using SatScan software. Clusters of infestation and clusters of trees in poorer condition were identified, and the presence of these clusters indicated adelgids and declining trees were not randomly dispersed within populations. The presence of multiple clusters in some populations supported the multiple foci model of spread. See detailed "Census" report, attached.**Expenses:** None charged, used free software and extant computer resources**Objective #3:** Document genetic variability via DNA sequence analysis of four individuals within each population.**Status:** Incomplete. DNA was extracted from trees from three populations. Some DNA sequences were generated but the sequencing facility we used changed procedures in June 2007 and the sequences we received subsequently were not acceptable. We plan to use a different sequencing facility but this component may require additional time.**Expenses:** DNA primers, polymerase and cost of sequencing and lab disposables.**Objective #4:** Analyze leaf micromorphology of four trees within each population.**Status:** Completed. Stomatal characters were scored for five trees from three populations (NL; LF; LV) and three trees for one population (DP). For each tree, 8-47 counts were conducted on

specimens and these were subdivided into the north-south side from which the leaves were collected. In each microscope field of view, the numbers of stomates and epidermal cells were counted and field length and width were measured. These counts and measures were used to calculate the standard stomatal characteristics of stomatal index (SI), stomatal density (SD), and stomates per unit leaf length (SL). See detailed "Leaf Morphology" report, attached.

Expenses: Undergraduate student researcher stipend (Graham Cooke)

Objective #5: Dissemination of findings

1. Presentation to Northeast Tennessee Nursery Association, 17 October 2007

Title: *Microscale analysis of the distribution of hemlock wooly adelgid in newly colonized and heavily infested forests*

Expenses: None

2. Presentation at Southern Appalachian Man and the Biosphere conference, 22 October 2007

Title: *Microscale analysis of the distribution of hemlock wooly adelgid in newly colonized and heavily infested forests*

Expenses: Registrations paid by ETSU

3. Invited Presentation, Hemlock Wooly Adelgid Conference, Hartford CT, 14 February 2008

Title: *Using demographics and cluster analysis on HWA spread patterns*

Expenses: Paid by ETSU

B. GIS Data

Locations for Carolina Hemlocks surveyed at Nolichucky site, spring 2007:
Taken by Tim McDowell using Garmin eTrex

Waypoint #	Latitude	Longitude	Elevation
58: 1st Carolina hemlock	36.09858	82.44284	
59: 1st Carolina hemlock	36.10076	82.44477	532m
60: 2nd Carolina hemlock	36.10074	82.44442	540m
61: 3rd Carolina hemlock	36.10030	82.44397	563m
62: 4th Carolina hemlock	36.10026	82.44366	553m
63: 5th Car. hemlock	36.10044	82.44413	549m
64 5th Car. hemlock	36.10044	82.44413	549m
65: Parking Lot	36.10501	82.44632	526m

Census transect "Start" and "End" points:
Nolichucky

	W longitude minutes	N latitude minutes	Elevation	
Start 0 m	36.10078	82.44470		
End	36.10026	82.44365	556 m	

Start 0 m	36.16.154	82.07.683	2564 ft	
End 60 m	36.16.176	82.07.706	2608 ft	

Linville

Start 0 m	35.94938	81.92299	1020 m	
At 22 m trail turns 45° to "right" facing away from origin				
Middle 60 m	35.94888	81.92332	1039 m	
End 100 m	35.94869	81.92355	1026 m	

C. Thesis

Graduate student Jordan Baker is in his second year of the masters program. Jordan had planned to emphasize a molecular phylogeny of the genus *Tsuga* but his advisor, Dr. McDowell, found that a group of noteworthy plant systematists had already submitted for publication a manuscript on the phylogeny of *Tsuga*. Moreover, a group in North Carolina at NC State University was conducting a molecular analysis of variation in *Tsuga caroliniana*. Consequently, Jordan is re-designing his thesis with a shift to an emphasis on differences in seed characteristics among species in the genus *Tsuga*. Jordan expects to complete his thesis in December 2008.

D. Publications

None. We anticipate a publication after a re-census is completed in the summer 2008.

E. Images

Images are provided on CDs/DVDs for sites and the census transect and for leaf sections used for stomatal counts.

F. Meeting with titles of presentation

See Objective #5 in "A" above.

G. Popular article for Appalachian Highlands Science Journal

We will prepare an article after completion of the re-census, if that timeframe is acceptable.