Excerpted from *Ecological Considerations for Risk Management of the Hemlock Woolly Adelgid in the Hocking Hills, Ohio USA* by Nicole I. Stump

4.2 GIS Mapping of Eastern Hemlock Stands

A key component to effective monitoring and management of HWA infestations is mapped information about the distribution of eastern hemlock stands, especially for establishing monitoring routes or prioritizing treatment areas. Therefore, eastern hemlock stands within the Hocking Hills region were mapped to be able to provide natural resource managers with a GIS layer that could be used in decision making for management of HWA. Eastern hemlock stands were digitized off of 1ft resolution color leaf-off orthophotographs available from OGRIP's (Ohio Geographically Referenced Information Program) statewide imagery program in a compressed MrSID mosaic by county. Hocking and Fairfield counties were needed for complete coverage of the Hocking Hills Region. Visual features such as texture and color were used to distinguish eastern hemlock from other conifer species such as white pine, which typically are even-aged and planted in rows creating a relatively smooth surface. Previous studies using GIS to map hemlocks stands have divided the landscape into three main topographic positions: ravines, benches, and slopes (Ross et al. 2003). Information on topographic position and other ancillary spatial information, such as aspect and soil type were used for a dual purpose, to determine what landscape variables characterize typical hemlock stands and to use that information to more readily discriminate eastern hemlock from other coniferous species by understanding where it is more likely to occur.

A topographic position layer was generated by combining a variety of spatial analysis methods within ESRI® ArcGIS™ 9.2 and ArcView 3.0. A digital elevation model (DEM) for the study area was developed by interpolating a raster using "Topo to Raster" on a mosaic of digital line graphs from 1:24000 USGS topographic maps of the area. Topographic position classes were first derived by running the DEM through a slope position classification available via an ArcView extension developed by Jeff Jenness, Topographic Position Index (TPI) v. 1.3a. The model output consists of six classes: ridge, upper slope, middle slope, flat slope, lower slope, and valley according

to Weiss (2001). Although the model captured the ridge versus other positions well, lower slopes and some valley areas were in the same class; therefore, only the ridge layer was extracted from the model. Using the Spatial Analyst tools in ArcMap, a model of percent slope was generated. The resulting slope model was then reclassified into slope (>30%) and not slope (<30%); the slope layer was extracted from the model. To divide the slope layer into upper slope and lower slope, the Curvature tool available in the Spatial Analyst tools was used to determine concavity and convexity. Positive values represented upper slopes and negative value signified lower slopes. The ridge layer and two slope layers were combined and the remaining areas constituted the ravines or bottomlands. The final model divides the Hocking landscape into the following categories: ridge, upper slope, lower slope, and ravine or bottomland.

The final GIS layer for eastern hemlock was compared with other spatial information to characterize the distribution of the species. A model of aspect was generated from the DEM using the Spatial Analyst tools available in ESRI ArcGIS™ and compared with the eastern hemlock. The grid for aspect was converted to vector data and clipped by the polygons for eastern hemlock. The clipped aspect layer was then dissolved by aspect class and areas were calculated for each aspect. GIS layers for state forest, park and nature preserves were merged into a single layer for public and used to compare the area of eastern hemlock on private versus public. Within the category of public, the area of hemlock on each management type was also considered.

GIS 5.1 Mapping of Eastern Hemlock Stands

The resulting GIS layer for eastern hemlock stands shows a rather patchy distribution, with contiguous areas of eastern hemlock occurring on the slopes of several drainages (Figure 11). Covering approximately 6150 acres, eastern hemlock accounts for 3% of the total forest area in Hocking County. Eastern hemlock most commonly occurs on upper slopes (45%) and lower slopes (40%), with some stands on the bottomlands (13%) and very few on ridges (2%) based on the topographic position model. The primary aspects of the slopes with eastern hemlock is west (19%), northwest (17%) and southwest (15%), with a relatively even distribution across the remaining NSEW directions; less than 1% of eastern hemlocks mapped occurred on flat areas. The most frequently occurring soil type in eastern hemlock stands is CeF (43%),

the Cedarfalls-Rock outcrop complex. The soils are characterized as deep and well drained, with a dark grayish brown friable coarse sandy loam surface layer about 5 inches thick. Slopes are considered very steep, ranging from 40-70%, with cliff heights of 40-200 feet (Lemaster & Gilmore 1989). Other soil types include DkF (Dekalb-Shelocta Rock Outcrop Complex) (18%), SbE (Shelocta-Berks Complex) (15%), and SaD (Shelocta Silt Loam 15-25% slopes) (6%), those soil types with less than 5% are not reported here. In terms of ownership, 54% of eastern hemlock occurs on public lands and 46% are privately owned. Of the eastern hemlock forests that are on public land, 21% are managed as nature preserves and 12% as parks. The private landholdings include 426 parcels, with some private landowners owning multiple parcels.

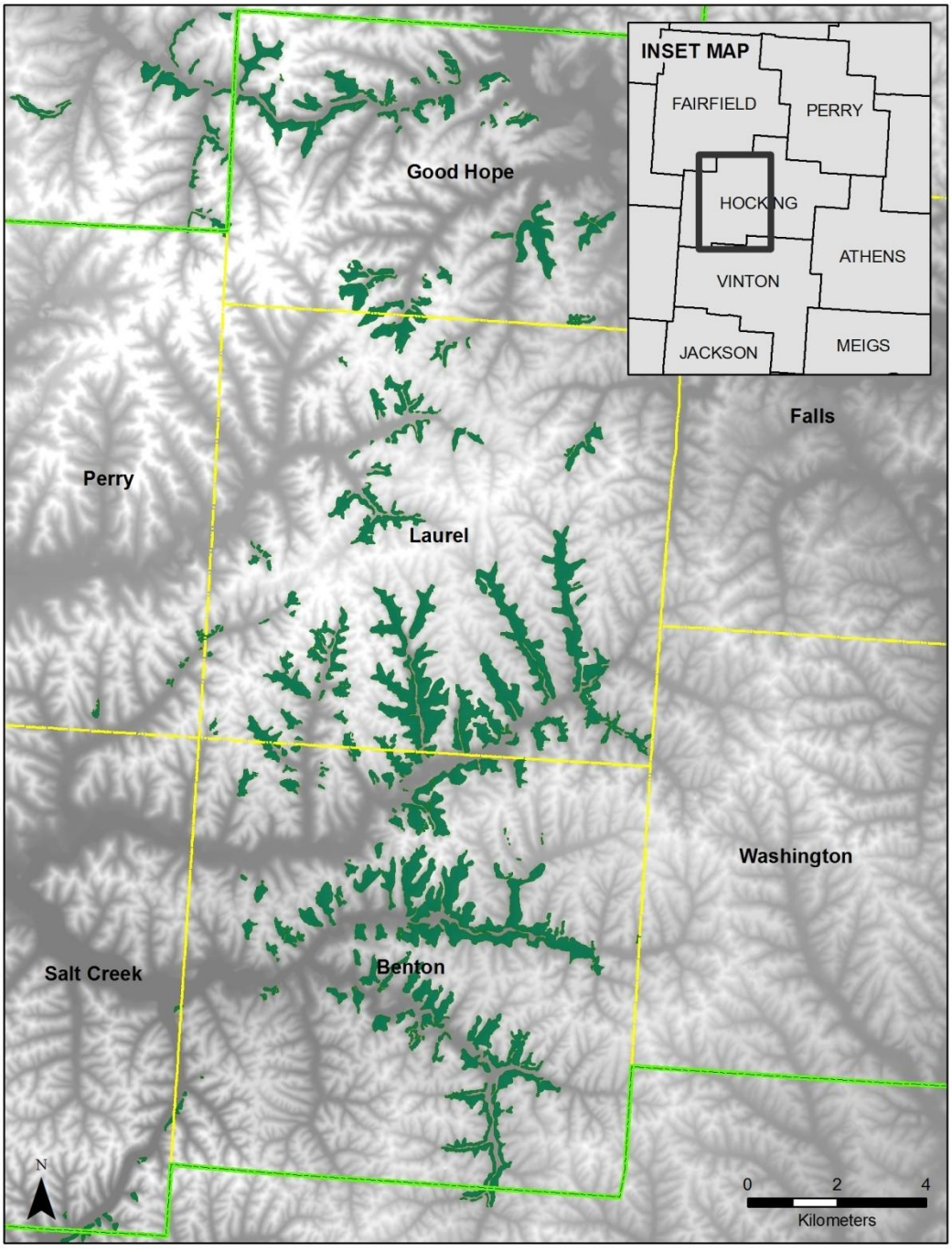

Figure 11: Distribution map of eastern hemlock in the Hocking Hills Region within Hocking County Townships.