

Localized Invasion Spread of Hemlock Woolly Adelgid Defoliation

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Previous analyses of historical spread of the hemlock woolly adelgid (HWA) indicate that its spread across eastern N. America has been anisotropic, spreading much faster to the north and south than to the west. These analyses also indicate that spread to the west has been limited by the density of hemlock, while spread to the north has been constrained by cold winter temperatures that reduce the growth of adelgid populations. Many agents have been cited as factors in movement of adelgid eggs and crawlers including wind, wildlife, and humans. Transport of adelgids by birds migrating along flyways oriented in a north-south fashion has been suggested as an explanation for the anisotropic pattern of spread, but the importance of this mechanism has never been established. Previous analyses of HWA spread have focused at the continental scale but little information is available about spread over smaller spatial scales. Here we provide an analysis of HWA spread over smaller spatial distances, spanning < 300 km in northern New Jersey (USA). As an alternative to direct sampling of insects, we used remotely-sensed data to reconstruct the distribution of the first wave of defoliation and infer from this the spatial dynamics of HWA spread. A geographical information system was used to estimate spread speed and the timing of invasion was related to topographic features as well as the degree of connectivity of host habitat patches. Results indicate a strong relationship between the timing of adelgid-caused defoliation with elevation and the size of Hemlock patch but little effect of distance from the nearest damaged habitat in the previous year. These results suggest that localized spread of HWA is not strongly contagious as would be expected from localized dispersal but instead spread seems to function in spatially broader fashion, indicative of long-range passive dispersal.

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