Effects of cold-air-pooling microclimates on species composition in New England forests

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Background & Objectives

Cold-air pooling is a globally occurring meteorological phenomenon that results in temperature inversions with lower temperatures at low relative to high elevations. These inversions are often formed when radiative surface cooling after sunset forms dense, cold air that drains downslope and pools in sheltered, low-lying areas, like depressions or valleys. Cold-air pools can be diurnal or may persist for days and, due to a lack of vertical mixing, air in these inversions becomes partly decoupled from the overlying free atmosphere. Thus, cold-air pooling areas may act as microrefugia that buffer organisms from climate change by enabling species persistence and facilitating species range shifts. By favoring and excluding certain tree species, cold-air pooling may also influence ecosystem functions linked to plant traits, such as soil carbon storage.

We aimed to determine whether cold-air pooling influences the vegetation composition of northern forests. We hypothesized that sites with more frequent cold-air pooling would display unexpected patterns in vegetation composition across elevation, as much as cold-adapted species at low elevations.

Methods

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Results

Sites with more cold-air pooling displayed inverted forest composition patterns across elevation.

- Cold-air pooling occurred at all sites, but was most frequent at the Nulhegan Basin and Second College Grant (Fig. 2).
- Where cold-air pooling was frequent, the lowest elevations were dominated by cold-preference species and higher elevations were dominated by warm-preference species (Fig. 1). The nonlinearity observed at Second College Grant suggests that the highest plots are above the cold-air pooling boundary (Fig. 1a). No strong vegetation pattern across elevation was observed in the westernmost site where cold-air pooling was less common (Fig. 1c).
- Forest stands in cold-air pooling areas were composed of species with traits that facilitate slow organic carbon turnover. These areas may therefore maintain plant communities linked to key ecosystem functions like carbon storage in the face of climate change.

Key Findings

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Literature Cited


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