

Submitted Abstract

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Title	The Shrinking Season: Observations Of Warming Winters, And Impacts And Adaptations By Ice Climbing Guides In The Northeastern United States.
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Abstract

This study considers the impacts of climate change on ice climbing and the winter guiding community in the ice-climbing hotbed of Mount Washington Valley, New Hampshire, by combining archival photo analysis, climate modeling, and social research methods. The Mount Washington Valley was among the first areas where modern ice climbing was popularized and supports a vibrant winter climbing community with numerous guiding concessions.

A weekly ice climbing conditions report maintained since 2001 (www.NEclimbs.com) includes photographs of popular ice climbing routes at crags throughout the Mount Washington Valley. The photographic record ($n = 330$) for Standard Route (WI3), a frequently guided climb, was analyzed by an experienced guide who rated ice quality based on the presence of ice and perceived hazards visible in each photo (e.g. holes, running water, etc.). Annual season lengths were estimated based on the number of records with climbable ice. The resulting dataset was date-aligned with daily temperatures recorded at similar aspect and elevation ~11km distant from Standard Route. Observed season lengths were positively correlated with the number of days with average temperatures below zero ($R\text{-squared} = 0.71$).

The study team used locally constructed analog climate model ensembles for the region surrounding Standard Route to simulate maximum and minimum daily temperatures for the period 1980 through 2100. Average daily temperatures were used to estimate days below zero and cumulative freezing potentials for each season. Season lengths are expected to decrease by 30 and 60 days (from 100 days) on average under RCP 4.5 and RCP 8.5 by 2100, respectively, suggesting some winters with no climbable ice are probable under a high-emissions scenario.

Mount Washington Valley guides participated in a survey ($n = 20$) and focus group ($n = 5$) oriented around their observations of, and impacts and adaptations to changing winters. Variables which reduced guides' abilities to consistently deliver positive experiences to their clients included fewer days of climbable ice, warmer than normal temperatures, and frequent rain events. Guides cited increased visitation, social media hype, and warming impacts as variables which compounded risk and hazards on popular ice climbs. Adaptations included shifting schedules to days with favorable weather, 'scouting' climbs in the days prior to guiding, and choosing rock climbing over ice climbing.

This study contributes to emerging research examining the consequences of a warming climate for winter recreation in mountainous areas by providing insights relevant to recreation-focused adaptation planning in (and beyond) the Mount Washington Valley.