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Evaluating the role of ivy (*Hedera helix*) in moderating wall surface microclimates and contributing to the bioprotection of historic buildings

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ABSTRACT

The role of ivy (*Hedera helix* L.) on building walls is much debated, with arguments being put forward for it playing a biodeteriorative role (for example through ivy rootlets exploiting cracks and holes) as well as suggestions that it might provide some bioprotection (for example by the ivy canopy protecting the walls from other agents of deterioration such as frost). We have carried out a year-long study of the influence that ivy canopies play on wall surface microclimates at five sites across a range of climatic settings within England, using iButtons to monitor temperature and relative humidity fluctuations at the wall surface on ivy-covered and exposed walls. Hourly data illustrates a general mediating effect of ivy canopies on both temperature and relative humidity regimes. The ivy reduces extremes of temperature and relative humidity, with the most clearcut differences for temperature. Across all five sites the average daily maximum temperature was 36% higher and the average daily minimum temperature 15% lower on exposed vs ivy-covered surfaces. Differences in the exposure level of studied walls (i.e. whether they are shaded or not by trees or other walls) influenced the degree of microclimatic alteration provided by the ivy canopy. Other important factors influencing the strength of the ivy impact on microclimate were found to be thickness of the canopy and aspect of the wall. A detailed analysis of one site, Byland in North Yorkshire, illustrates the seasonal differences in impact of ivy on microclimates, with insulation against freezing being the dominant effect in January, and the removal of high temperature 'spikes' the dominant effect in July. The observed moderating role of ivy canopies on wall surface microclimates will reduce the likelihood of frost and salt deterioration to the building materials, thus contributing to their conservation. Further research needs to be done on other potentially deteriorative roles of ivy before an overall bioprotective role can be assumed, but the significant impact of ivy on wall surface microclimates across England is clear.

1. Introduction

Vegetation is an integral part of the built environment yet the role of plant growth on buildings, monuments, and cultural heritage remains an ongoing question [1]. Higher plants are reported to cause stone weathering through biological, physical and chemical processes that decay walls and buildings [2–4]. Conversely, plant cover has also been cited for its beneficial effects including protection, conservation and aesthetic appeal [5–8]. The key issue is whether plants are agents of bioprotection or biodegradation. Research that examines plant impact *in situ* is essential for better understanding of the role of biophysical processes on walls and buildings.

Ivy is a common evergreen plant with dark-green, angular leaves that is widespread in urban and rural settings. Known in ancient and medieval times, ivy was first catalogued in 1727; more recent work identifies ivy's native range across northern latitudes (roughly 30–60°) from the Canary Islands through Europe to Asia [9]. After introduction to the Americas, India and East Asia ivy is now present in much of the world [10]. Ivy seeds are dispersed by birds; the plant is tolerant of frost, shade, drought and atmospheric pollution with its natural habitat being woodlands [11]. A member of the Araliaceae family, the ivy genus *Hedera*, ivy's generic name, is comprised of about 15 species including the dominant Common or English ivy, *Hedera helix* [9]. Known for its wall climbing tendencies, ivy is found on buildings and walls throughout the British Isles.

The role of ivy on walls is in dispute; in 314 BC Theophrastus first claimed ivy was harmful. Whereas public opinion often asserts that

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