Towards defining minimum requirements for violet feeding fritillaries in woodland.

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Introduction

British woodland wildlife is heavily influenced by past management systems; woodland management traditions such as coppice and wood pasture have created complimentary suites of habitat for woodland plants and animals (Peterken, 1993; Sutherland & Hill, 1995). However, butterflies are sensitive to landscape alterations, experiencing greater net losses than either birds or plants in Britain (Thomas et al. 2004). Using a resource-based approach to define habitat (Dennis et al. 2003), we describe key elements of the woodland environment that influence abundance of the five British violet-feeding Nymphalidae fritillary species: high brown (Argynnis adippe), pearl bordered (Boloria euphrosyne), small pearl bordered (Boloria selene), dark green (Argynnis aglaja), and silver-washed (Argynnis paphia). Key woodland vegetation, structure, physical habitat components and fritillary abundance were quantified at two limestone woodland sites in north-west England (Fig 1). These sites contain core UK populations and are actively managed for fritillary conservation. Management techniques developed in this region have been used nationally as an exemplar for appropriate fritillary management (Ellis & Wainwright, 2008). The identification of key habitat resource requirements is of primary importance as ecological research informs practical conservation management (Dennis, 2004).

Method

Both fritillary abundance and habitat characteristics were quantified at two limestone woodland sites: Witherslack Woods, Cumbria, and Gait Barrows National Nature Reserve, Lancashire.

Quantitative component

• Transect sections for research were identified based on aggregated fritillary numbers during the 2007 – 2009 flight seasons, and defined as either ‘rich’ or ‘poor’ in population status.
• A random stratified sampling technique, with proportional sampling, measured environment variables that relate to previously described larval and adult resource requirements: vegetation, physical and structural characteristics.

Statistical component

A primary principle component analysis (Table 1 & 2) informed the grouping of environmental variables for further analysis (Table 3).

• Logistic regression investigates the potential relationships between multiple environmental variables and the fritillary ‘rich’ and ‘poor’ status of transect sections.

Results

The aggregated fritillary numbers identified transect sections as being either ‘rich’ or ‘poor’ for fritillary population status (mean fritillary population: ‘rich’ 622.43 ± 61.47 km-1; ‘poor’ 20.47 ± 4.92 km-1; ANOVA: F1,14 = 109.88, n = 15, p < 0.001). The logistic regression analysis obtained a Wald test and the exponential of the coefficient

The Wald criterion demonstrates that the environmental variables percentage cover of canopy cover (p < 0.001), leaf litter (p = 0.011) and violet cover (p = 0.001) make a significant contribution to the prediction, whilst the environmental variables percentage cover of vegetation at 0.4m (p = 0.063), 1.5m (p = 0.489) and 0m (p = 0.515) contribute to the final model without a demonstration of statistical significance. Violet cover exerts a strong positive influence whilst canopy cover, leaf litter and vegetation ≥ 0.4m negatively influence fritillary population status.

Conclusion

• Both structure and physical characteristics of the woodland environment influence British violet feeding fritillary population status.
• In association with the positive influence of the larval host plant, Viola spp., we establish structural and physical environmental components that influence fritillary population status.
• We identify the potential for an associated vegetation height threshold. These data suggest that, given the requisite violet coverage, woodland structural components of canopy cover and vegetation ≥ 0.4m set a ‘tipping point’ between ‘rich’ and ‘poor’ fritillary populations.
• The implications of any height significance may prove beneficial to conservation management strategies. The identification of habitat minimum requirements can act as a guide for intervention and conservation management planning in similar habitats.
• Where environmental management resources are limited there is a clear need for prudent investment in time, manpower and money, especially in the successful implementation of conservation management for conservation dependent species.

References