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Relationships between vegetation, site type and stand structure in coniferous plantations in Britain

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Abstract

Plant communities (ground and field layer species) within a wide range of coniferous forest stands across Britain were classified using the National Vegetation Classification, and community composition and diversity related to stand structure and site characteristics. Data were collected from 12 plantation forest sites, encompassing a range of climatic conditions (uplands, foothills, and lowlands), crop types (Scots pine, Sitka spruce, Norway spruce and Corsican pine), and crop ages (pre-thicket, mid-rotation, mature and over-mature). Vegetation communities in lowland sites were poorly correlated with semi-natural woodland analogues, with \hat{r}^2 goodness-of-fit coefficients less than 40%. The highest coefficients were obtained for mature and over-mature pine and spruce stands in the uplands and foothills climatic zones. These stands were matched most closely to semi-natural pinewoods and oakwood communities.

Principal components analysis produced four summary soil vectors and four habitat structure vectors, that described 84 and 79% of the variability in the site and stand structure data, respectively. These vectors were related to plant community composition, species richness and diversity using canonical correspondence analysis and correlation analysis. Variation in community composition was related principally to a soil fertility gradient, defined by increasing pH, exchangeable Ca, and available N in $\text{NO}_3^{\hat{a}}$ form, coupled with decreases in soil organic matter and N in NH_4^+ form. Vascular plant and bryophyte species diversity was inversely related to available N.

Uplands and foothills Scots pine and Sitka spruce sites had plant communities typical of acid, infertile soils, whereas lowland Norway spruce sites had communities associated with high soil fertility.

Plant community composition and diversity was also significantly related to measures of vertical stand structure. Pre-thicket plots, with high values for field layer vertical cover; had distinctive communities and were more diverse than mid-rotation and mature plots; which had high canopy cover values, and low shrub and field layer cover. A positive relationship was recorded between deadwood volume and bryophyte species diversity, with over-mature Sitka spruce stands in the uplands having particularly high volumes of deadwood due to windthrow. This influence of stand structure suggests that plant community diversity can be enhanced in commercial conifer forests by extending rotation lengths, introducing alternative silvicultural systems such as shelterwood, and increasing deadwood volumes.



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Keywords

Biodiversity; Forest management; Soils; Plant communities

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