



Comparison of breeding bird assemblages in conifer plantations managed by continuous cover forestry and clearfelling



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ABSTRACT

Continuous cover systems are increasingly advocated for stand management but the implications for biodiversity in European forests, and specifically in plantations of non-native trees, are poorly understood. Timed point counts were used to quantify differences in species richness and abundance of breeding birds supported by conifer plantations (with major Sitka spruce components) under two contrasting management systems in upland Britain: continuous cover forestry (CCF) and clearfelling with replanting (CFR). Each CCF study area was paired with a comparable CFR study area. Sample points within CCF areas were divided into areas with extensive regenerating understorey and areas with none; sample points within CFR study areas were placed within young thicket and pre-thicket stands (trees < 10 years old) and older stands (15–30 years old). Poisson GLMMs were used to identify differences in bird species richness and abundance between the four treatments testing the predictions: (a) CCF can support an enhanced assemblage of forest birds relative to CFR (including mature CFR); and (b) CFR can support a broader range of open habitat and shrubland species relative to CCF (including those with a regenerating understorey). Ranking forest types in descending order of species richness gave: CCF with shrub understorey > CCF without shrubs > young pre-thicket CFR > mature CFR. Many 'mature forest birds' were more abundant, or recorded only, within CCF (e.g. blackcap, wood warbler, redstart and hawfinch). A small number of species associated with young-growth ('shrubland' and 'shrub-layer' species) were most abundant in pre-thicket CFR but a CCF understorey supported some species at densities approaching those found in pre-thicket CFR. Simulations of the effect of increasing the proportion of plantation under CCF indicated for example that a plantation managed exclusively as CCF could support as few as 53% of the willow warblers as one managed exclusively as CFR. A plantation managed exclusively as CCF could support as few as 70% of the lesser redpolls as one managed as CFR, but could support twice as many blackcaps. CCF could be of greater conservation value to many forest birds than CFR. However, CCF may not support such high densities of some species (e.g. dunnoek, willow warbler and lesser redpoll) as those found in young growth stage CFR. Forest management that includes some young growth areas alongside CCF could prove to be a strategy that maximises the capacity of a forested landscape to support a greater diversity of bird species.

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1. Introduction

Managed plantations generally support an impoverished avifauna compared to many more natural woodlands but both species richness and bird abundance can be positively related to their structural complexity (Nájera and Simonetti, 2010). By 'structural complexity' we mean the vertical foliage profile; woods with complex structures typically have much low woody understorey

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vegetation and a multi-layered canopy. Management regimes operating within plantations can influence that structural complexity, with bird communities supported by the more mature plantations increasingly resembling those supported by native non-planted forests (Moss et al., 1979; Peterken et al., 1992; Hartley, 2002). The most mature plantations can support a number of forest-specialist species (Petty and Avery, 1990; Donald et al., 1997; Marion and Frochet, 2001). However young stages of plantation growth can also support important assemblages of birds that are associated with more open and shrubby habitats (Moss et al., 1979; Bibby et al., 1985; Marion and Frochet, 2001). Some studies

have even shown species richness to decline in older plantations (Moss et al., 1979; Marion and Frochot, 2001), however it should be noted that, in these studies, the most mature plantations (older than the pole-stage) were rare or not surveyed.

Two alternative (and broadly defined) management systems for plantations are clearfelling with replanting and continuous cover forestry. Clearfelling with replanting (hereafter termed CFR) are where forest coupes are cut down and replanted typically for conifers on 30–60 year rotations, and is how most conifer plantations in Britain (the location of the present study) have been managed to date (Mason et al., 1999). This has resulted in plantations comprising adjacent but discrete coupes of different but uniform aged, and therefore also uniformly structured, stands of trees (hence it also being referred to as an even-aged silvicultural system). Coupe sizes vary from less than 10 ha to several hundreds of hectares, though the largest coupes are now scarce in Britain. Continuous cover forestry (hereafter CCF) is increasingly advocated in Britain (but is more widely established in mainland Europe). This includes management systems referred to as low intensity silvicultural systems, uneven aged silviculture, 'jardinage' and 'Plenterwald' (O'Hara, 2001; Pommerening and Murphy, 2004; Pukkala, 2006). Felling within CCF managed plantations is more selective with the removal of single trees to small coupes of up to about 0.25 ha in size. If seed sources and browsing pressure permit, then trees can naturally regenerate within the cleared areas, or otherwise by supplementary planting. CCF, as its name implies, retains a relatively continuous forest canopy cover across the plantation extent. Structural diversity amongst the crop trees is at a much finer scale than found within CFR and some trees can grow older, their maximum girth being effectively limited by the ease with which they can be felled and extracted with available machinery.

Studies of birds in semi-natural forests of North America, that are either managed through clearfelling or that are selectively felled to maintain uneven aged stands with near continuous cover, identify conflicts of interests between management that favours birds of mature forests and the maintenance of habitats for birds of woody, early successional communities (Costello et al., 2000; Thompson and DeGraaf, 2001; Gram et al., 2003). The birds of CFR managed forests are relatively well known (especially in north-west Europe) but the implications of alternative stand management for biodiversity in Europe is poorly understood. The implications of alternative stand managements in plantations of non-native tree species are similarly poorly understood. Alternative silvicultural systems, that deliver uneven aged stands of trees, have been proposed as a mechanism to improve the value of planted forests for biodiversity in Britain (Kerr, 1999) where there has been a policy shift from clearfell systems to CCF to achieve multi-purpose objectives that includes biodiversity (Davies and Kerr, 2011). Environmental accreditation and its associated premium prices for forest products are amongst the encouragement for forest managers to convert management of plantations to CCF, however there has been rather limited evidence of the expected benefits for birds (du Bus de Warnaffe and Deconchat, 2008) and the potential impacts on birds reliant on early successional growth stages perhaps not well considered.

An important difference between the two management regimes is the occurrence and distribution of young growth stage trees (saplings). In Europe, areas of low woody shrubs or early growth stages are important habitats notably, though not exclusively, for long distance migrant birds (Helle and Fuller, 1988; Fuller, 2012). Within CFR, pre-thicket and early thicket stage plantations are ecologically equivalent to shrubland (Askins, 2001; Hunter et al., 2001) which occurs as discrete uniform-aged blocks which can be extensive, occupying entire planted or restocked coupes. Within CCF, shrubs (or saplings) tend to occur as smaller clusters and are expected to be more heterogeneous in age and/or structure

dependent on the patchiness of the selective felling regime and opportunities for regeneration and tree growth within those felled patches. Within CCF, young trees or shrubs will also occur as an understorey though their density may depend on thinning intensity. Young growth trees or shrubs are infrequent within CFR after canopy closure, typically at about 12–15 years old in British conifer plantations. It is likely that the bird communities found within understorey shrubs/saplings of CCF will differ from those of the more open and extensive patches of young growth CFR (Fuller et al., 2012).

Although changes in plantation management from CFR to CCF might be expected to deliver conservation benefits in an enhanced mature-forest avifauna (though this was not demonstrated in a study in Belgium; du Bus de Warnaffe and Deconchat, 2008), there is a possible consequence that the shrubland avifauna could diminish. Data collected from spruce plantations in upland Scotland and Wales are presented that quantify differences in the breeding birds (species richness and abundance) under the contrasting management regimes of CFR and CCF. These are used to assess the predictions:

- (a) CCF can support an enhanced assemblage of typically mature forest bird species relative to CFR plantations (including the more mature stands within CFR);
- (b) CFR can support a broader range of open habitat and shrub specialist species relative to CCF managed plantations (including those with a developed regenerating shrub understorey).

The relative contributions to bird conservation of the two management regimes are considered and examined using simulations of plantation areas under different proportions of the contrasting management regimes.

2. Methods

2.1. Study sites

Suitable study sites in Britain were limited by the availability of CCF-managed plantations that were (a) sufficiently developed for their structure to differ from that of maturing CFR-managed sites, and (b) large enough to be expected to be able to support a bird community with the potential to differ from surrounding CFR plantations. Plantations under transformation to be managed as CCF but where trees were still of uniform age and less than 30 years old were not suitable as they were structurally identical to CFR plots of a similar age. CCF plots that were less than five ha in extent were also considered unsuitable because of the limited bird populations that their restricted size could potentially support. Study areas were also required to include a major Sitka spruce (*Picea sitchensis*) component to ensure representativeness with the majority of plantations that are likely to become managed as CCF in the uplands of Britain. Within these restrictions, four suitable CCF study areas were identified (Fig. 1). For each CCF study area, a similarly sized CFR study area was selected. Each CFR site was within 15 km of its paired CCF site (in all but one case the distance was <5 km) and was of comparable altitude, aspect and underlying geology.

Point counts were used to sample breeding birds within the study areas. Points were at the intersections of a 150 m grid to permit representative sampling of a sufficient area within each management treatment (CCF or CFR) while also ensuring relative independence of data collected from each point (Bibby and Buckland, 1987). Each management treatment was further divided into two sub-categories. Sampling points within CCF sites were

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