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The role of managed coniferous forest in the conservation of reptiles

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ABSTRACT

Commercially managed coniferous forest is often considered detrimental to wildlife despite their early developmental growth stages being well utilised by some species from a number of different taxa. Our study investigated the use of different aged conifer plantations by reptiles in southern England using arrays of artificial refuges, placed within 20 plantations of varying age, to determine the presence of reptiles annually within each between 2009 and 2013. All six native British reptile species (adder *Vipera berus*, grass snake *Natrix natrix*, smooth snake *Coronella austriaca*, common lizard *Zootoca vivipara*, sand lizard *Lacerta agilis*, slow worm *Anguis fragilis*) occurred in conifer plantations. Excluding the slow worm, which occurred in plantations of all ages, the majority of reptile observations occurred in plantations up to 20 years old and where tree canopy cover was below 65% with the highest numbers occurring in 3–12 year old plantations with a canopy cover below 50%. The early stages of plantation growth are utilised well by reptiles but become increasingly unsuitable over time. Furthermore, the availability of suitable reptile habitat is transient, depending on the rate of tree growth, the timing and extent of tree thinning and felling operations, the size of the plantation units and their proximity to adjacent areas inhabited by reptiles.

Our study shows that coniferous forests can be managed so that both timber production and biodiversity conservation can be achieved through the formation of a mosaic of relatively small, multi-aged plantations and that small changes in ground preparation and habitat management practices may further enhance its suitability for reptiles and, by implication, for species from other taxa. The results of our study also have pertinence for species conservation and biodiversity within similar managed forestry throughout the world.

1. Introduction

Habitat change is the biggest threat to the conservation of many taxa worldwide including herpetofauna (Sala et al., 2000; Gardner et al., 2007; Böhm et al., 2013; Reading and Jofré, 2015) with land use practices, including forestry, agriculture and domestic cattle grazing being some of the main drivers of this change (Lindenmayer and Fischer, 2006; Gardner et al., 2007). Over the last 250 years the lowland heaths of southern England, the premier habitat for reptiles in the UK that supports all six native species (Jofré and Reading, 2012), have decreased significantly in area due mainly to fragmentation, the subsequent development of the resulting small fragments, and the loss of large areas to commercial forestry (Rose et al., 2000).

During the 20th century an increasing demand for timber led to a massive increase in the area of plantation woodland in Britain, including the planting of new coniferous plantations on open land such as heathland, dunes and moorland (Donald et al., 1998). In addition, much of the early planting of forests was in large, single-species, even-aged blocks of fast growing and mainly non-native conifers (Donald et al., 1998). However, by the end of the last century substantial changes were introduced into UK forestry policy and practices with biodiversity conservation becoming an important objective (Quine et al., 2004). Significant progress has been made since then in restoring habitats, where afforestation was considered inappropriate, and in restructuring some of the largest commercial forests by creating more heterogeneity in terms of the size, shape and age structure of forest compartments in order to increase and improve their perceived habitat conservation value (Donald et al., 1998). Unfortunately this change has occurred in the absence of a recognised need for detailed research into the specific habitat requirements of many species of conservation interest

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(Quine et al., 2004). As a consequence there remains a common perception that plantation forests are ecological deserts that do not provide habitat for valued organisms (Brockerhoff et al., 2008) despite assemblages of open-habitat taxa occurring in clear-felled and young pine stands worldwide (Barbaro et al., 2005; Wright et al., 2007; Wilson et al., 2009; Uribe and Estades, 2014; Calladine et al., 2015; Sharps et al., 2015).

Within the UK the habitat requirements of native reptile species, all of which also occur throughout Europe, occurring on lowland heathland (adder *Vipera berus* (L.), grass snake *Natrix natrix* (L.), smooth snake *Coronella austriaca* (Laurenti), common lizard *Zootoca vivipara* (Jacquin), sand lizard *Lacerta agilis* (L.) and slow worm *Anguis fragilis* (L.)) are relatively well known (Frazer, 1983; House and Spellerberg, 1983; Reading and Jofré, 2015, 2016) and show that they all have a preference for a well-structured habitat (Spellerberg and Phelps, 1977; Edgar et al., 2010; Reading and Jofré, 2009, 2015, 2016) that meets their thermal requirements, offers foraging opportunities, and shelter (Spellerberg and Phelps, 1977; Edgar et al., 2010). Of these the sand lizard and smooth snake, both European protected species (EPS), are at the north-western edge of their geographical range and are heathland specialists in the UK.

Despite this, the use of conifer plantations by reptiles, during the different stages of the complete cycle of a commercial rotation (planting, thinning and final harvesting), has not previously been studied in the UK. The objective of this study was, therefore, to investigate how conifer plantations of different ages are used by the six native UK reptile species and how this use may change over time and provide insight for the conservation of species from other taxa that occur in managed forest worldwide.

2. Methods

2.1. Study area and management

This study was carried out between January 2009 and December 2013 in Wareham Forest (50°44′N, 2°08′W), a coniferous forest planted on lowland heathland, over tertiary deposits of acid sands and gravels (Mann and Putman, 1989), in southern England by the Forestry Commission. The forest is managed on rotation, with trees clear-felled at about 60 years, maintaining a mosaic of clear fell, tree stands of varying ages, open heath and permanent open ground. Some tree stands older than 60 years are kept to maintain a mosaic landscape design and to increase the amount of available dead wood habitat. The primary tree species is Corsican pine *Pinus nigra* (Melville). Sapling pine trees are planted, approximately 1.8 m apart, in late winter/early spring one year after clear-felling plantations of mature trees, preparing the ground using a powered scarifier during the previous winter and sometimes spraying with herbicide. Following planting, the early years (≈0–12 years old) of forest growth are described in forestry as the 'pre-thicket' stage. During the following 'thicket stage' (≈10–30 years old), the trees form an increasingly dense canopy preventing most light from reaching the forest floor, resulting in an almost total absence of ground flora. Plantations are thinned for the first time after 25–30 years, by approximately 40%, and subsequently every five years. The 'high forest' stage (≈30–70 years old) results in a higher, often more open, canopy allowing more light to reach the forest floor and the re-establishment of some ground flora. This is most marked at the forest edge.

The ground flora growing within the plantations, and the area surrounding them, is that characteristic of dry and wet lowland heath communities comprising common heather *Calluna vulgaris* (L.), bell heather *Erica cinerea* (L.), cross-leaved heath *Erica tetralix* (L.), purple moor grass *Molinea caerulea* (L.) and bristle bent *Agrostis curtisii* (Kerguelen) as the dominant species. Dwarf gorse *Ullex minor* (Roth) and bracken *Pteridium aquilinum* (L.) are also common within the plantations.

2.2. Project set-up

In December 2008 twenty pine plantations of different ages were selected within Wareham forest (Fig. 1), and grouped into four broad age classes with five plantations in each: *Sites A:* planted

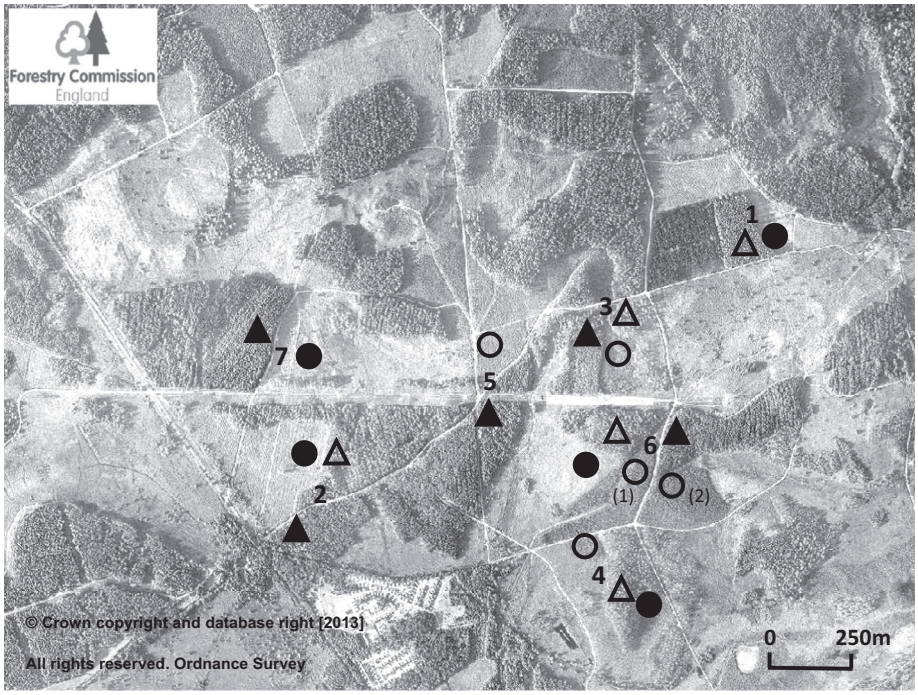

Fig. 1. Map of the study area within Wareham Forest showing the positions of the 20 reptile refuge arrays relative to each other. Site age categories: (A) – △; (B) – ▲; (C) – ○; (D) – ●.