

# DO IRISH FORESTS PROVIDE HABITAT FOR SPECIES OF CONSERVATION CONCERN?

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Cite as follows: Irwin, S., Kelly, D.L., Kelly, T.C., Mitchell, F.J.G., Coote, L., Oxbrough, A., Wilson, M.W., Martin, R.D., Moore, K., Sweeney, O., Dietzsch, A.C. and O'Halloran, J. 2013 Do Irish forests provide habitat for species of conservation concern? *Biology and Environment: Proceedings of the Royal Irish Academy* 2013. DOI: 10.3318/BIOE.2013.22

Received 4 June 2013. Accepted 6 August 2013. Published 30 December 2013.

## ABSTRACT

The importance of plantation forests for biodiversity conservation is greatest in landscapes that have experienced significant loss of natural forest ecosystems and the plantation forest estate continues to expand, as is the case in Ireland. We investigated the role of plantation forests in supporting forest plants, invertebrates and birds of conservation concern in comparison to semi-natural woodlands in Ireland. Of the 169 vascular plant species, 97 bryophyte species, 162 spider species, 159 beetle species and 36 bird species recorded 5, 3, 9, 1 and 5 species of conservation concern, respectively, were recorded. Many of these were found in semi-natural woodlands, highlighting the importance of the retention or restoration of these habitats for forest biodiversity. A number of species of conservation importance were also recorded in plantation forests demonstrating that the role of these forests in the provision of habitat for biodiversity conservation should not be overlooked.

## INTRODUCTION

Although native forest cover in Ireland was once extensive, historical deforestation has resulted in just 1% of land area covered in native forest remaining today (Cross 2012). Ambitious afforestation targets and policy incentives have been set by the Irish Government since the introduction of the Forestry Act of 1946 (McCarthy *et al.* 2003; COFORD Council 2009; DAFM 2010) and forest cover has increased to almost 11% (ITGA 2012). The majority of this afforestation, particularly during the twentieth century, has been undertaken using non-native coniferous tree species (Forest Europe *et al.* 2011).

As a result, Ireland today has an unusual forest landscape, characterised by small plantations embedded in a matrix of open land that is largely dominated by agriculture. This is similar to much of Britain, but in stark contrast with much of the rest of Northern Europe, where large areas of continuous forest cover are common. The decrease in Ireland's natural forest cover and subsequent extensive afforestation, almost exclusively with non-native tree species, has undoubtedly been associated with some loss of native forest biodiversity. While the value of plantation forests for biodiversity is typically considered to be low, this overlooks the potential for enhancing the biodiversity value of an area through sympathetic management such as planting on sites with poor biodiversity or planting native deciduous tree species (Fabbio *et al.* 2003;

Brockerhoff *et al.* 2008; Coote *et al.* 2012; O'Connell *et al.* 2012; Duguid and Ashton 2013). Plantation forests, in fact, compare favourably with many other intensive land uses in terms of the biodiversity they support, for instance, annual crop agriculture, degraded forest or deforested land (Carnus *et al.* 2006; Buscardo *et al.* 2008; Bremer and Farley 2010). This is particularly true in Ireland, which has relatively low numbers of forest specialist species compared with other parts of Europe, and forests are inhabited mainly by generalist species adapted to living in a range of habitat types (Mitchell 2006; Oxbrough *et al.* 2010; Coote *et al.* 2012; O'Connell *et al.* 2012).

It is not just the potential to support number of individuals (abundance) and species (richness) that is important in determining the value of forests for biodiversity, but also the potential to provide habitat for species of conservation concern (Carnus *et al.* 2006; Negro *et al.* 2013). The aim of this paper is to assess the importance of Irish forests (both plantations and native or semi-natural woodlands) for vulnerable species of plants, invertebrates and birds.

## MATERIALS AND METHODS

As part of a large study of forest biodiversity in Ireland (O'Halloran *et al.* 2011), surveys of ground vegetation, invertebrate (ground- and canopy-dwelling spiders and beetles, and lepidoptera) and

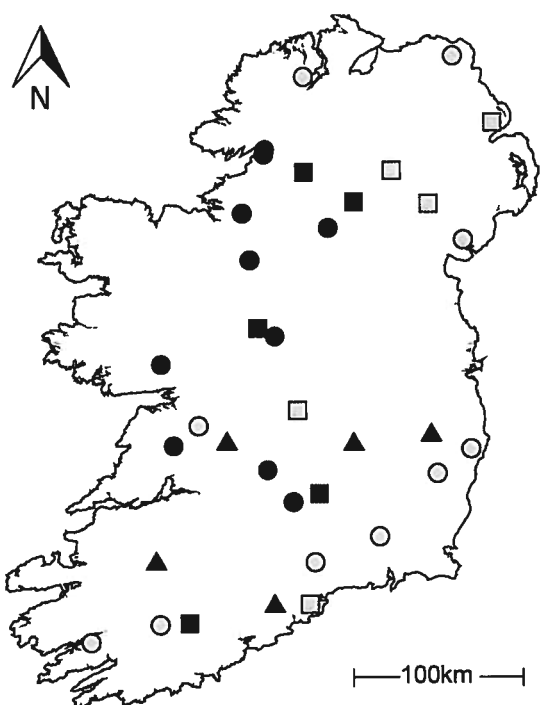


Fig. 1—Location of Irish forests used in this study. ▲ Second rotation Sitka spruce plantations ( $n = 4$  per location), ■ Norway spruce/Scots pine mixes and pure Norway spruce site pairs, □ Norway spruce/oak mixes and pure Norway spruce site pairs, ● Native ash woodlands and ○ Native oak woodlands.

bird diversity were carried out during 2007 and 2008 at 60 forest sites distributed throughout Ireland (Fig. 1). The study sites were: 20 Sitka spruce (*Picea sitchensis*) second rotation plantations (5 each of 4 age classes: 4–8yrs, 9–19yrs, 20–29yrs and 30–50yrs), 10 pure Norway spruce (*Picea abies*) plantations, 10 mixed commercially mature species plantations (5 Norway spruce/oak (*Quercus petraea/robur*), 5 Norway spruce/Scots pine (*Pinus sylvestris*)) and 20 semi-natural woodlands (10 oak dominated and 10 ash (*Fraxinus excelsior*) dominated).

Biodiversity surveys were conducted using standard sampling methodologies (O'Halloran *et al.* 2011). Vascular plant and bryophyte surveys were conducted by compiling information on percentage cover of each species in three 10m × 10m plots per site. Pitfall trapping was used to survey ground-dwelling spiders and beetles at each site. A novel canopy fogging technique was used for an in-depth study of canopy invertebrate biodiversity at a subset of study sites (six Sitka spruce plantations, six Norway spruce plantations, six oak-dominated semi-natural woodlands and six ash-dominated semi-natural woodlands). While pitfall trapping is the most widely used method of sampling forest invertebrates (Hill 2005), this

method samples only ground-dwelling species. Thermal fogging is a method of collecting invertebrates from forest canopies which is commonly used in tropical forest ecology research (Erwin 2013). This method uses a petrol-driven fogging machine to disperse a knock-down insecticide through the forest canopy allowing for the collection of fallen invertebrates. Although restricted by wet and windy weather conditions this method can provide valuable information on the biodiversity supported by forest canopies and is increasingly being used in temperate forest research (Floren and Schmidl 2008; Erwin 2013). Bird communities were surveyed using point counts at all study sites. The number of points at each site was dependent on site size, up to a maximum of six per site.

The classification of species conservation status varied across the different taxonomic groups. This classification is outlined below and summarised in Table 1. As there are currently no Red-lists for the majority of invertebrate species in Ireland the UK Red-List categorisation was used to provide an indication of conservation status (JNCC 2010).

## RESULTS AND DISCUSSION

A total of 623 species of plants and animals, not including lepidoptera, were recorded in the forest study sites, including 169 species of vascular plant, 97 bryophytes, 162 spiders, 159 beetles and 36 birds. Of these, five vascular plants, three bryophytes, nine beetles, one spider and five bird species of conservation concern, were recorded (Table 1). One third of all species recorded were forest specialist species including 30% of plants, 36% of invertebrates and 47% of birds. Typically fewer forest specialist species are found in Ireland compared with other European countries for a number of reasons including glaciation, island biogeography and extensive historic deforestation and associated loss of forest biodiversity (Mitchell 2006; Fuller *et al.* 2007; Kelly 2008).

### PLANTS

The moss *Daltonia splachnoides* was recorded in a young (4–8yrs) Sitka spruce plantation in County Limerick (Bosanquet *et al.* 2010). *Daltonia splachnoides* is classified as 'Vulnerable' in the Red Data Book of British Mosses and Liverworts (Church *et al.* 2001) and it is listed as 'Near Threatened' in Europe (ECCB 1995). Until recently, this elusive species was known only from damp native woodland habitats, mainly in the south-west. In the past two decades it has been found in conifer plantations at a number of locations in Counties Cork, Kerry and Limerick, and may be increasing its range (Bosanquet

**Table 1—Species of conservation concern recorded in Irish forests and the number of sites at which they were recorded in each of the forest types.**

Species	New Irish Record	Conservation status	Forest-associated	Plantation			Semi-natural woodland	
				SS (n = 20)	NS (n = 10)	Mix (n = 10)	Oak (n = 10)	Ash (n = 10)
Vascular plants								
<i>Salix x pontederiana</i>	X			1				
<i>Stachys officinalis</i>		Notable <sup>a</sup>	X	1				
<i>Prunus padus</i>		Notable <sup>a</sup>	X			1		
<i>Carex strigosa</i>		Notable <sup>a</sup>	X			1		
<i>Melica uniflora</i>		Notable <sup>a</sup>	X					1
Mosses								
<i>Daltonia splachnoides</i>		Near-threatened (Europe) Least Concern (Ireland) <sup>b</sup>		1				
<i>Sphagnum girgensohnii</i>		Near-threatened <sup>2</sup>		1				
<i>Plagiothecium laetum</i>		Vulnerable <sup>2</sup>	X	1				
Invertebrates								
<i>Anobium inexpectatum</i>	X	UK Red List <sup>c</sup>	X				2	
<i>Entelecara acuminata</i>	X		X				1	
<i>Coeliodes transversealbofasciatus</i>		UK Red List <sup>c</sup>	X				1	
<i>Kykliaocalles roboris</i>		UK Red List <sup>c</sup>	X				2	1
<i>Malthodes guttifer</i>		UK Red List <sup>c</sup>	X	1	1		4	3
<i>Mniophila muscorum</i>		UK Red List <sup>c</sup>	X				1	
<i>Orchesia minor</i>		UK Red List <sup>c</sup>	X			2		5
<i>Tetratoma ancora</i>		UK Red List <sup>c</sup>	X					1
<i>Athous campyloides</i>		UK Red List <sup>c</sup>		6	2	1		2
<i>Stenichnus poweri</i>		UK Red List <sup>c</sup>			1		1	
Birds								
Garden Warbler ( <i>Sylvia borin</i> )		Irish Green List <sup>d</sup> Nationally rare	X		1		1	
Linnet ( <i>Carduelis cannabina</i> )		Irish Amber list <sup>d</sup> SPEC <sup>d</sup>		2				
Grasshopper Warbler ( <i>Locustella naevia</i> )		Irish Amber list <sup>d</sup>		1				
Spotted Flycatcher ( <i>Muscicapa striata</i> )		Irish Amber list <sup>d</sup> SPEC <sup>d</sup>	X			1	2	2
Stock Dove ( <i>Columba oenas</i> )		Irish Amber list <sup>d</sup>					1	

SS = Sitka spruce; NS = Norway spruce; Mix = Norway spruce mix; Oak = oak-dominated semi-natural woodland; Ash = ash-dominated semi-natural woodland.

<sup>a</sup>Rare species typically found in woodland or a species indicative of long-established woodland (Perrin *et al.* 2008).

<sup>b</sup>Irish classification (Lockhart *et al.* 2012).

<sup>c</sup>UK classification (JNCC 2010).

<sup>d</sup>Irish classification list; SPEC = Species of European Concern (Lynas *et al.* 2007).

*et al.* 2010). This species is known in Europe only from Ireland and western Scotland, making it a species of conservation importance on a European scale.

*Sphagnum girgensohnii* was a new record for County Offaly and is listed as 'Near threatened' in the Irish Red Data Book for bryophytes (Lockhart *et al.* 2012). It was recorded in a Sitka spruce

plantation between 9 and 19 years old. *Plagiothecium laetum* was recorded twice during the current study in a similar aged Sitka spruce plantation in County Wicklow. It has only been recorded twice before in Ireland (Holyoak 2003) and is listed as 'Vulnerable' in the Irish Red Data Book for bryophytes (Lockhart *et al.* 2012).

A number of relatively rare and interesting vascular plant species were also recorded during the ground vegetation surveys of Irish forests. *Salix x pontederiana* (a hybrid between the willows *Salix cinerea* and *Salix purpurea*) was a new record for Ireland and was found in a young (4–8yrs) Sitka spruce plantation in County Limerick (Kelly *et al.* in press). *Stachys officinalis* (betony) is on the Flora (Protection) Order, 1999, S.I. No. 94/1999, and is classified as a 'Notable' species (Perrin *et al.* 2008), which refers to rare species typically found in woodland or a species indicative of long-established woodland. It was recorded in County Galway in a commercially mature (30–50yrs) Sitka spruce plantation established on historic woodland sites (present on the 1st edition OS maps c. 1840), adjacent to existing remnants of this woodland. Additional 'Notable' species recorded in plantation forests established on historic woodland sites were *Carex strigosa* (thin-spiked wood-sedge) and *Prunus padus* (bird cherry), both recorded in a Norway spruce/Scots pine mix in County Roscommon. Another 'Notable' species found in forest samples was *Melica uniflora* (wood melick), recorded in ash woodland in County Donegal.

#### INVERTEBRATES

Several forest species of lepidoptera (moths) and ground-dwelling spiders and beetles were collected solely in native woodlands in this study. This may suggest a degree of specialisation to more natural or undisturbed forests and the low cover of natural forest in Ireland may be a limiting factor in their distribution.

One new spider species record for Ireland was found during the canopy fogging of native oak woodlands. One male and one female specimen of the spider *Entelegara acuminata* were recorded in County Kilkenny. *E. acuminata* is locally common but patchily distributed in southern England, is rarer in northern England and has been recorded in Scotland (Harvey *et al.* 2002). Investigation of the distribution, status and habitat requirements of this species in Britain suggested that it could have been present in Ireland (McFerran 1997); it may have previously gone undetected in Ireland due to its arboreal lifestyle and small size (1.8–2.4mm).

Other forest associated species included *Pachygnatha listeri* and *Linyphia hortensis*. *P. listeri* (Tetragnathidae) is typically found in low vegetation in ancient or old woodlands (Harvey *et al.*

2002). Spiders from this genus build orb webs as juveniles but are active hunters as adults (Roberts 1993). Ten individuals were sampled in an oak woodland in County Kerry, two in an ash woodland in County Fermanagh and four in an ash woodland in County Roscommon. This species has a Palearctic distribution and is widespread across Europe; however, there are insufficient data to assess its status in Ireland (Nolan 2010). *L. hortensis* (family Linyphiidae) builds sheet webs on low vegetation and is typically found in both forest interior and edges. Individuals were collected in oak woodlands in Counties Down and Wicklow and in four ash woodlands in Counties Donegal, Leitrim and Tipperary. This species has a Palearctic distribution and is relatively widespread across Europe; however, there are currently insufficient data to assess its status in Ireland (Nolan 2010). The lack of records for both of these forest species may also be a reflection of their preferred micro-habitat in low vegetation layers. Although pitfall trapping is the most commonly used spider collection method in Ireland and elsewhere, low vegetation layers might not have been efficiently sampled by this method (Curtis 1980).

Four specimens of a new beetle species record *Anobium inexpectatum* were recorded in Counties Galway and Kerry. *A. inexpectatum* is on the UK Red List (JNCC 2010). This species is generally found in association with old broadleaved trees, and in particular with stems of ivy (*Hedera helix*) growing on these broadleaves. *A. inexpectatum* feeds on the wood of broadleaves only, and is rarely found in conifers.

In addition, eight Red-listed (JNCC 2010) beetle species were recorded in various forest types; several of these were woodland specialists. *Coeliodes transversealbofasciatus* feeds on oak and was recorded only in native oak woodlands in Ireland. *Kyklia-calles roboris* is a xylophage and was recorded in both ash and oak native woodlands, while the predatory *Malthodes guttifer* was recorded in both broadleaved and coniferous woodlands. *Mniophila muscorum* feeds on foliage and is found in moss on a variety of trees but was only recorded in native oak forests during this study. Individuals of *Orchesia minor* and *Tetratoma ancora* feed on fungi and are associated with fungi on deciduous trees; *O. minor* was recorded in both native broadleaved woodlands and non-native coniferous plantations during this study, whereas *T. ancora* was recorded in native ash woodlands only. Thus, in Ireland *O. minor* was sampled from a habitat (non-native coniferous forest) with which it has not previously been associated in the UK and Ireland. Two other red-listed species recorded in forest canopies in this study are not forest-associated species; *Athous campyloides* and *Stenichnus poweri* are more commonly found in open grassland habitats where

*A. campyloides* is phytophagous and *S. poweri* is an active hunter (Buckland and Buckland 2006).

Two additional forest-associated carabid beetles, *Oxyselaphus obscurus* and *Pterostichus oblongopunctatus*, were recorded in this study from native woodlands only. *O. obscurus* was collected in two ash woodlands, with 55 individuals found in County Clare and two individuals in County Roscommon. This species is typically found in wet woodlands or heavily vegetated sites and is widespread across the northern hemisphere. It is widespread in Ireland, though sparsely distributed (Anderson 2006), *P. oblongopunctatus* was collected in two oak woodlands in Counties Antrim and Kilkenny. This species is typically found under decaying bark or stones in woodlands (Anderson 2006). It occurs throughout Europe, but has a patchy distribution across the British Isles (Anderson 2006) and in Ireland, at least, this may reflect a lack of recording in suitable habitats.

Three forest-associated moth species, Clouded Magpie (*Abraxas sylvata*), Green Pug (*Pasiphila rectangulata*) and Large Emerald (*Geometra papilionaria*), were found solely in native woodlands in this survey. The Clouded Magpie has a larval feeding preference of Wych elm (*Ulmus glabra*) and English elm (*Ulmus procera*) (Emmet and Heath 1991). Five individuals of this species were collected during this study in an oak woodland in County Down. This species has a scarce distribution on the island of Ireland, with most records occurring in the north (Tyner 2010). Four Green Pug individuals were recorded in an oak woodland in County Wicklow. This species has a larval food preference for fruit trees of genera *Malus* and *Prunus* (e.g. apple, cherry and blackthorn) (Emmet and Heath 1991) and is widespread across Ireland (Tyner 2010). The Large Emerald moth has a feeding preference for birch (*Betula pendula*), but also feeds occasionally on alder (*Alnus glutinosa*), hazel (*Corylus avellana*) and beech (*Fagus sylvatica*) (Emmet and Heath 1991). This moth species was collected in two oak woodlands in Counties Kilkenny and Down during the current study. This species is widespread and locally common across Ireland (Tyner 2010).

No ground-dwelling spider or beetle species were found exclusively in plantation forests in this study; however four moth species were found exclusively in conifer plantations and were not present in oak or ash woodlands. These were the Barred red (*Hylaea fasciaria*), Cloaked pug (*Eupithecia abietaria*), Satin beauty (*Deileptenia ribeata*) and Tawny-barred angle (*Macaria liturata*). All of these species utilise conifers as a larval food plant, including trees of natural or semi-natural origin (Yew *Taxus baccata*, Scots pine *Pinus sylvestris*) but also non-native trees Norway spruce, Douglas fir (*Pseudotsuga menziesii*), Sitka spruce, Noble fir (*Abies procera*) and Silver fir (*Abies alba*).

## BIRDS

The only nationally rare bird species recorded in Irish forests during this study was Garden Warbler (*Sylvia borin*), a summer migrant with an estimated Irish population of less than 400 pairs (BirdLife International 2004). This species prefers to breed in dense broadleaved woodland and scrub, and was recorded in a native oak woodland in County Antrim. Most of the other bird species recorded during this project are nationally widespread and frequent in habitats other than woodland such as parkland, hedgerows, scrub and gardens. However, early successional forests can be important in the conservation of open habitat specialists. The Linnet (*Carduelis cannabina*) and Grasshopper Warbler (*Locustella naevia*) were both found in young (4–8yrs) Sitka spruce plantations in this study. Both are on the Amber list in Ireland and the Linnet is also a Species of European Concern (SPEC) (Lynas *et al.* 2007). Though it occurs at densities too low to have been recorded by this project, one of Ireland's rarest raptors, the Hen Harrier (*Circus cyaneus*), breeds regularly in young (4–8yrs) forests (Irwin *et al.* 2008). No bird species of conservation concern were recorded at later stages of the plantation forest cycle during this study.

Two bird species of conservation concern were recorded in native woodlands during this study, the Spotted Flycatcher (*Muscicapa striata*) and the Stock Dove (*Columba oenas*). Both are on the Amber list of birds of conservation concern in Ireland and the Spotted Flycatcher is also a Species of European Concern (Lynas *et al.* 2007). The Spotted Flycatcher was found in both oak and ash woodlands but not in Sitka spruce plantations, while the Stock Dove was found in a single oak woodland. The Spotted Flycatcher requires open areas and perches for foraging, so the typically dense, uniform nature of Sitka spruce plantation canopies may be less suitable. In the case of Stock Dove, native woodlands probably offer tree hollows for nesting which are not present in Irish plantation forests (Snow and Perrins 1998).

## CONCLUSIONS

This intensive survey of plantation forests throughout Ireland has revealed that these sites offer habitats to some nationally rare and threatened species of plants, invertebrates and birds. The potential of plantation forests to enhance national biodiversity is thus evident and so the planning and management of these forests should incorporate this goal. Recent research is providing some guidance on how plantation management can be used to improve the value of forests for biodiversity (Smith *et al.* 2007; Coote *et al.* 2012; O'Connell *et al.* 2012;

Oxbrough *et al.* 2012). Our results also indicate that biodiversity conservation measures should target the expansion and restoration of semi-natural woodlands (including by conifer removal); these sites may be important refuges for forest-associated species in intensively managed landscapes.

#### ACKNOWLEDGEMENTS

This work was funded by the Department of Agriculture, Food and the Marine and the Irish Research Council under the National Development Plan 2006–2013. The authors wish to thank Coillte and private landowners for assistance with selection of, and access to, the study sites.

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