Assessing and optimising the influence of plantation forestry on bird diversity in Ireland

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Abstract

Continued expansion of commercial forests in Ireland, following earlier periods of large-scale deforestation, has the potential for both negative and positive interactions with biodiversity. This paper provides an overview of the interactions between commercial forest development and birds. An analysis of the influence of forestry on breeding bird species, based on 'impact scores', suggests that, while the overall impact is likely to be positive, the degree to which positive impacts outweigh negative impacts is highest for common bird species and for some species-groups (raptors and owls for example). Impacts on some species-groups (notably breeding waders) are more likely to be negative, although they may be mitigated by sensitive siting of new forests.

Keywords: afforestation impacts, waders, raptors, owls, passerines, guidelines

Introduction

Historic and pre-historic deforestation in Ireland has resulted in a landscape with one of the lowest forest covers of any European Union country (Department of Agriculture Food and Forestry 1996, Aalen *et al.* 1997). However, commercial afforestation with non-native tree species, has increased forest cover from about 1.5% at the start of the 20th century to over 9% currently. The state forestry strategy aims to increase forest cover to 17% by the year 2030, based on projected planting of up to 20,000 ha per annum. Planting is comprised mainly of non-native coniferous species, particularly Sitka spruce (*Picea sitchensis)*, on short rotations (typically 40-50 years). Overall, some 80% of the forest estate is comprised of conifers, though 10% of the latter is comprised of mixed species stands. The broadleaf forest estate comprises about 100,000 ha of which 6,000 ha are managed by Dúchas, The Heritage Service (Forest Service 2000).

As in other countries where forest cover in recent historical times was low (see, for example, Nature Conservancy Council 1986) the rapid increase in afforestation in Ireland has led to some concerns about its potential negative impacts on biodiversity. Existing 'natural' or 'semi-natural' forest (primarily broadleaved species) has been subject in the past to losses through replacement by conifers and lack of proper management, among other factors (Hickie *et al.* 1995). However, in general, the impact of forestry in Ireland arises from afforestation, rather than deforestation of forest land. Indeed, the extent of deforestation in Ireland in the past suggests a potential for a positive contribution of forestry to biodiversity. In particular, sensitive placement and management of new forest

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blocks may provide a means of improving the conservation status of species that have suffered losses from earlier deforestation.

Birds provide an important case study of forestry/biodiversity interactions. The authors carried out research as part of a COFORD-funded project, 'Forest location and enhancement strategies for biodiversity' from 1995 (O'Halloran *et al.* 1998, Walsh *et al.* 2000). This research examined the interactions between breeding birds and tree species, tree age, forest area, 'edge length' and other parameters, especially in coniferous plantations. Existing data on the distribution of afforestation-sensitive bird species have also been analysed, to identify 'hotspots' of bird diversity (particularly in upland and other moorland areas) most at risk from inappropriate afforestation or other land-use pressures.

Drawing on the findings of the project, and other relevant studies, here we review:

- the likely impact of current afforestation policies on breeding birds in Ireland;
- appropriate guidelines to help minimise negative influences and maximise positive influences on bird diversity.

The influence of forestry in Ireland (primarily relating to afforestation with conifers) can be seen in terms of:

potential losses –

- loss of open-country habitat for species of high conservation importance;
- reduced diversity of bird species compared with broadleaved woodland (if the latter is replaced with coniferous woodland);
- acidification in some sensitive catchments impacting stream-dwelling birds;

potential gains –

- mature plantations providing optimum habitat for a range of bird species;
- young conifers providing habitat for additional species;
- afforestation possibly providing opportunities for restoration of species of high conservation importance.

Materials and methods

We applied a simplified scoring system of 'likely afforestation impacts' to 109 breeding bird species (Appendix). These include species with total breeding populations of at least 5-10 pairs in Ireland during one or both of the national 'breeding atlas' surveys, in 1968-72 (Sharrock 1976) and 1988-91 (Gibbons *et al.* 1993). Each species was given a simple, semi-quantitative directional score, reflecting the authors' assessment of the potential impact of current afforestation policies in Ireland on their population status. These scores were based on knowledge of the habitat requirements of each species (see Lack and Venables 1939, Cramp and Simmons 1980, Avery and Leslie 1990, Gibbons *et al.* 1993), and the likelihood that afforestation would either improve or negatively affect habitat availability or quality. This assumes afforestation of open-country (upland or lowland) habitats, including riparian and marsh habitats to a limited degree, primarily with conifers but with increasing levels of broadleaves, with possible effects on water quality under certain geological conditions. We have assumed that replacement of existing broadleaved woodland with conifers no longer occurs to any significant extent.

The direction and magnitude of each score are crude measures of the likelihood of positive or negative impact on total or local populations of each species: + (strongly positive), [+] (moderately positive), 0 (neutral or slight), [-] (moderately negative) or - (strongly negative impact).

We took the analysis a stage further, to attempt a semi-quantitative assessment of likely afforestation impact on Irish birds. The scores for each species were expressed numerically (e.g. '+' = +1.0, '[-]' = -0.5, Table 1), then weighted by measures of 'abundance' or 'scarcity' and summed across species.

Table 1. *Scoring system used for broad assessment of likely impact of cozmmercial afforestation on Irish bird species.*

Score	*Numeric equivalent*	*Likelihood of impact*	*Example*
+	+1.0	Strong (positive)	Crossbill *(Loxia curvirostra)*
[+]	+0.5	Moderate (positive)	Hen harrier *(Circus cyaneus)*
0	0.0	Neutral	House sparrow *(Passer domesticus)*
[-]	-0.5	Moderate (negative)	Dipper *(Cinclus cinclus)*
-	-1.0	Strong (negative)	Golden plover *(Pluvialis apricaria)*

As good population estimates are available for but few Irish bird species, we used the number of standard 10-km squares with records of a species (Sharrock 1976, Gibbons *et al.* 1993) as a measure of relative abundance, and the inverse of this number as a measure of scarcity. For each species, two alternative data sets were available, from surveys in 1968-72 (Sharrock 1976) and 1988-91 (Gibbons *et al.* 1993), respectively. Four alternative sets of 'afforestation impact scores' were thus derived for the Irish avifauna and for selected components thereof (for example 'raptors and owls'). As the baseline data (numbers of squares with records) differ between these alternatives, these scores have also been expressed as a percentage of the maximum possible score (for a given scheme).

Results

Our qualitative assessments of the likely impact of current afforestation policies on each individual bird species are given in Appendix. The proportional distribution of species among the five 'impact' categories provides one measure of likely afforestation impacts (Figure 1).

For the Irish avifauna as a whole, our assessment suggests that a greater number of species are likely to experience positive rather than negative impacts from afforestation, although the largest number of species falls into the 'neutral' category. However, the results are significantly more skewed towards positive impacts for passerine than for non-passerine species (Figure1).

For other subdivisions of the Irish avifauna, the greatest contrast is between breeding waders, such as curlew, (generally negative scores) and raptors and owls (generally positive). Weighting towards species scarcity, by using the inverse number of 10-km squares with breeding records places more importance on species that are scarcer or have more localised distribution. From this perspective, a strong negative influence of afforestation on scarcer species (golden plover for example) would have a greater influence on the overall 'forest impact score' than a similar influence on a commoner species (skylark for

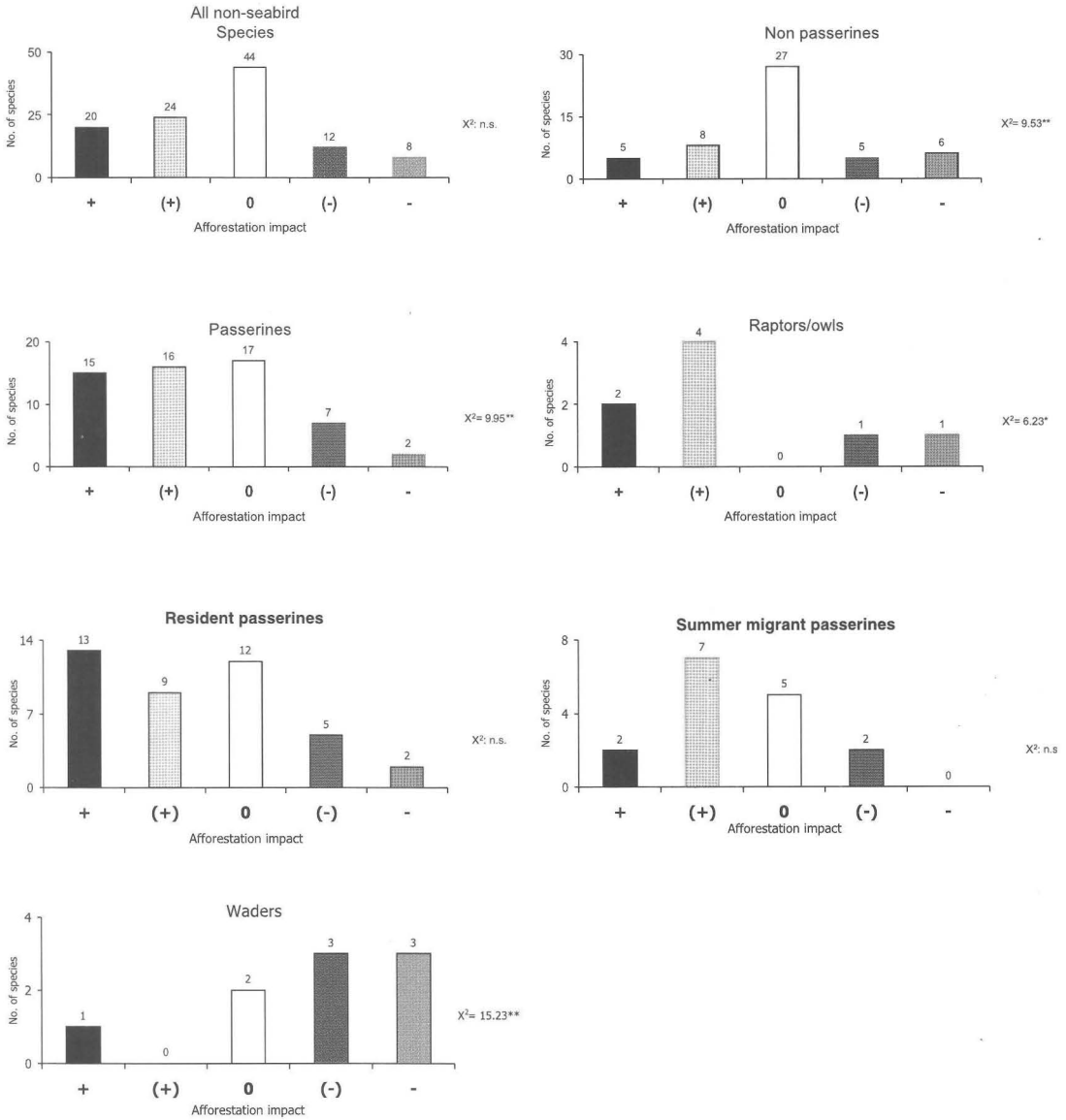

Figure 1. *Likely directional impacts of afforestation on population status of breeding bird species (excluding seabirds) in Ireland.*

Species-groups where the number of species differs significantly from other groups are indicated by * ($p \leq 0.05$), ** ($p \leq 0.01$) or *** ($p \leq 0.001$), based on X^2 tests using +/[+] combined, 0, and -/[-] combined (3 x 2 cell comparisons). Summer migrant and resident passerine groups are compared with each other (no significant difference).

example). Conversely, scarcer species likely to benefit from afforestation would make the greatest contribution to 'positive' impact scores under this scheme.

When impact scores are weighted by a factor representing species scarcity and combined across species, overall scores are positive for passerines (particularly for resident species based on 1968-72 population data), but negative for non-passerine species as a whole (Table 2). Most strikingly, overall scores are strongly negative for wader species, and strongly positive for raptors and owls. Only waders show a strong tendency towards negative scores here, although other individual ground-nesting species (red grouse for example) would score similarly.

Table 2. *Assessment of potential impact of afforestation (primarily with conifers, secondarily with broadleaved trees) on population status of breeding bird species (excluding seabirds) recorded in Ireland during the 1968-72 and 1988-91 'breeding atlas' surveys.* (Analysis combines directional impact scores for each species with measures of abundance to assess balance of probability of positive or negative impacts on bird populations or distribution.)

Species group	*Overall forest impact score (weighted towards scarce species)*[1]		*Overall forest impact score (weighted towards common species)*[2]	
	1968-1972[3]	1988-1991[4]	1968-1972[3]	1988-1991[4]
All non-seabird species	0.25	-0.01	15896[5]	14531
Score as % of max possible[5]	*+17*	*-1*	*+26*	*+28*
Non-passerines	-0.16	-0.03	2109	1707
score as % of max possible	*-19*	*-4*	*+10*	*+11*
Waders	-0.03	-0.03	-1385	-1291
Score as % of max possible	*-67*	*-55*	*-32*	*-41*
Raptors/owls	0.02	0.01	1680	1193
Score as % of max possible	*+30*	*+26*	*+53*	*+47*
Passerines	0.41	0.03	13787	12824
Score as % of max possible	*+67*	*+8*	*+34*	*+35*
Summer migrant passerines	0.07	0.02	3025	2697
Score as % of max possible	*+33*	*+10*	*+34*	*+35*
Resident passerines	0.34	0.01	10762	10127
Score as % of max possible	*+82*	*+6*	*+34*	*+35*

[1] Overall score (weighted towards scarce species) = sum of {(species score) x (inverse of number of squares occupied)}.

[2] Overall score (weighted towards common species) = sum of {(species score) x (number of squares occupied)}.

[3] 68-72 = score based on squares occupied by each species in 1968-72 survey.

[4] 88-91 = based on 1988-91 survey.

[5] Score as % of maximum for example, the maximum possible score for all species, weighted by abundance, for the 1968-72 data set would be +61135 (1.0 X total number of species/square records), compared to an actual score of +15896 (26%)}.

The alternative assessment treats afforestation influences on commoner species as the more important component of the overall impact scores. (In reality, the 'true' impact of afforestation can be seen as intermediate between the impact assessed by this and the previous approach.) Impact scores weighted towards common species show broadly comparable differences between species-groups, but the overall scores are more strongly positive (or less negative) than in the case of scarcity-weighted scores.

Discussion

The approach taken in this analysis is analogous to the use of 'oil vulnerability indices' for assessment of sensitivity of seabird species to surface pollutants (Williams *et al.* 1995), in that we attempted to 'score' the potential impacts of a human activity (in the present case, afforestation) on a range of bird species, based on aspects of their ecology. In doing so, we aim to clarify the potential impacts in broad but semi-quantitative terms, without focusing in too much detail on individual species, as one possible basis for decision-making in relation to current afforestation. Crucially, afforestation's potential for positive as well as negative influences is taken into account, while acknowledging that the direct influence may vary markedly between species or groups of species.

The results of our analysis suggest that commercial afforestation is likely to have the following overall impacts on Irish breeding birds:

- a slight positive, or a neutral, impact on the population or conservation status of scarce bird species as a whole, and a moderate positive impact on common bird species;
- a moderate or slightly negative impact on non-passerine species;
- a moderate or strongly negative impact on wader species;
- a moderately positive impact on raptors and owls;
- a more positive impact on passerine than on non-passerine species.

Losses or gains shown by some species between the 1968-72 and 1988-91 surveys produce a few anomalies. For example, the overall score weighted towards scarce passerines is less strongly positive when based on 1988-91 data, possibly reflecting changes in abundance of some species -for example, both siskins and crossbills greatly increased their distribution between the 1968-72 and 1988-91 surveys, having undoubtedly benefited from increased availability of mature conifers nesting or feeding (Sharrock 1976, Gibbons *et al.* 1993).

In crude terms, our analysis suggests that commercial afforestation is likely to have a positive impact overall on the population or conservation status of Ireland's avifauna. However, this must be qualified by noting that the more common species are likely to benefit to the greatest degree since many of the most abundant Irish birds can nest successfully in woodlands. Some scarcer species can also benefit from afforestation, for example raptors, owls, and nightjars (Morris *et al.* 1994). In contrast, waders and other ground-nesting species of open habitats are particularly vulnerable to negative impacts of afforestation in particular locations (see, for example, Nature Conservancy Council 1996).

In essence, we have attempted to address the question: 'is commercial afforestation good or bad for Irish birds?' We acknowledge that answers to such a question may be oversimplified, without further qualification and interpretation. It may be the case that the scores generated by the present analysis are biased or subjective. We suggest that the analysis (cf. Appendix) could be repeated by other workers with a view to arriving at more objective and generally agreed scores. The real test will be through monitoring the actual responses of bird species to afforestation over future decades. In the meantime, there are clearly ways of maximising positive impacts and minimising negative impacts on Irish birds, and we provide some suggestions and guidelines below.

Guidelines for optimising afforestation impacts on Irish birds

Sensitive placement of new forests, taking account of altitude, bird habitats and species distributions, are essential to minimising potential negative impacts on Irish birds. Analy-

sis of distributional data for bird species most sensitive to negative impacts of afforestation (species with a high proportion of their population nesting or feeding in open upland or other moorland areas) indicates that northern and north-western parts of Ireland are the most sensitive to afforestation (Walsh *et al.* 2000). Our recent research suggests that positive impacts are most likely to accrue from discontinuous (blocks separated by open areas) afforestation of high quality, low-altitude land previously used for livestock grazing, particularly if a high proportion of broadleaved species is included. Mosaics of different tree species and (in particular) tree age-classes within a given forest (at medium to large scales), are also likely to produce strong positive impacts on avian diversity (O'Halloran *et al.* 1998, Walsh *et al.* 2000). Connectivity with Ireland's rich hedgerow (field boundary) habitat, present at probably the highest density in Europe (Smal 1995), would further enhance the avifauna.

Results of this project have been recently used to produce a draft manual 'Forestry and bird diversity in Ireland: a management and planning guide' (Walsh *et al.* 2000), with particular reference to coniferous forests. This should be consulted for more detailed advice.

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APPENDIX

Likely afforestation impacts assessed for individual bird species. Impacts range from + (moderately positive) to – (strongly negative). Scientific names of species referred to in the text are also included.

Barn owl *Tyto alba*	(+)	Hen harrier *Circus cyaneus*	(+)
Blackbird *T. merula*	+	Hooded crow *C. corone*	(+)
Blackcap *S. atricapilla*	(+)	House martin *Delichon urbica*	0
Blue tit *P. caeruleus*	(+)	House sparrow *Passer domesticus*	0
Bullfinch *Pyrrhula pyrrhula*	(+)	Jackdaw *Corvus monedula*	0
Buzzard *Buteo buteo*	(+)	Jay *Garrulus glandarius*	+
Canada goose *Branta canadensis*	0	Kestrel *Falco tinnunculus*	(+)
Chaffinch *Fringilla coelebs*	+	Kingfisher *Alcedo atthis*	0
Chiffchaff *P. collybita*	+	Lapwing *Vanellus vanellus*	(-)
Chough *Pyrrhocorax pyrrhocorax*	0	Linnet *C. cannabina*	0
Coal tit *Parus ater*	+	Little grebe *Tachybaptus ruficollis*	0
Collared dove *Streptopelia decaocto*	0	Long-eared owl *Asio otus*	+
Common sandpiper *Actitis hypoleucos*		Long-tailed tit *Aegithalos caudatus*	(+)
Common scoter *Melanitta nigra*	0	Magpie *Pica pica*	(+)
Coot *Fulica atra*	0	Mallard *A. platyrhynchos*	0
Corn bunting *Miliaria calandra*	0	Meadow pipit *Anthus pratensis*	(-)
Corncrake *Crex crex*	0	Merlin *F. columbarius*	–
Crossbill *Loxia curvirostra*	+	Mistle thrush *T. viscivorus*	+
Cuckoo *Cuculus canorus*	0	Moorhen *Gallinula chloropus*	0
Curlew *Numenius arquata*	–	Mute swan *Cygnus olor*	0
Dipper *Cinclus cinclus*	(-)	Nightjar *Caprimulgus europaeus*	+
Dunlin *Calidris alpina*	–	Oystercatcher *Haematopus ostralegus*	0
Dunnock *Prunella modularis*	(+)	Peregrine *F. peregrinus*	(-)
Eider *Somateria mollissima*	0	Pheasant *Phasianus colchicus*	(+)
Gadwall *Anas strepera*	0	Pied wagtail *M. alba*	0
Garden warbler *S. borin*	(+)	Pochard *Aythya ferina*	0
Goldcrest *Regulus regulus*	+	Quail *Coturnix coturnix*	(-)
Golden plover *Pluvialis apricaria*	–	Raven *C. corax*	(-)
Goldfinch *C. carduelis*	(-)	Red grouse *Lagopus scoticus*	–
Grasshopper warbler *Locustella naevia*	(+)	Red-breasted merganser *Mergus serrator*	0
Great crested grebe *Podiceps cristatus*	0	Red-throated diver *Gavia stellata*	–
Great Tit *P. major*	(+)	Redpoll *C. flammea*	+
Greenfinch *Carduelis chloris*	(+)	Redshank *Tringa totanus*	(-)
Grey heron *Ardea cinerea*	(+)	Reed bunting *E. schoeniclus*	0
Grey partridge *Perdix perdix*	(+)	Reed warbler *A. scirpaceus*	0
Grey wagtail *Motacilla cinerea*	(-)	Ring ouzel *Turdus torquatus*	(-)
Greylag goose *Anser anser*	0	Ringed plover *Charadrius hiaticula*	0

Robin *Erithacus rubecula*	+
Rock dove *Columba livia*	0
Rock pipit *A. spinoletta*	0
Rook *C. frugilegus*	0
Ruddy duck *Oxyura jamaicensis*	0
Sand martin *Riparia riparia*	0
Sedge warbler *Acrocephalus schoenobaenus*	0
Shelduck *Tadorna tadorna*	0
Shoveler *A. clypeata*	0
Siskin *C. spinus*	+
Skylark *Alauda arvensis*	–
Snipe *Gallinago gallinago*	(-)
Song thrush *T. philomelos*	+
Sparrowhawk *Accipiter nisus*	+
Spotted flycatcher *Muscicapa striata*	(+)
Starling *Sturnus vulgaris*	0
Stock dove *C. oenas*	(+)
Stonechat *S. torquata*	(+)
Swallow *Hirundo rustica*	0
Swift *Apus apus*	0
Teal *A. crecca*	0
Tree sparrow *P. montanus*	0
Treecreeper *Certhia familiaris*	+
Tufted duck *A. fuligula*	0
Twite *C. flavirostris*	–
Water rail *Rallus aquaticus*	0
Wheatear *Oenanthe oenanthe*	(-)
Whinchat *Saxicola rubetra*	(+)
Whitethroat *Sylvia communis*	(+)
Willow warbler *P. trochilus*	+
Wood warbler *Phylloscopus sibilatrix*	(+)
Woodcock *Scolopax rusticola*	+
Woodpigeon *C. palumbus*	+
Wren *Troglodytes troglodytes*	+
Yellowhammer *Emberiza citrinella*	0