Deer in Irish commercial forests

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Abstract
The history of deer species, their current distribution and their numbers are summarised, but there is paucity of reliable information about deer populations in Ireland. Aspects of how deer use commercial forests and particular habitat preference are described. The issue of deer in commercial forests in Ireland is discussed in the context of a number of local studies, though there is a lack of knowledge as to the extent of issues discussed. The types of impacts and damage observed in Irish plantation forests, particularly bark stripping and browsing, show the likely effects on the plantation crops. Calculating the potential economic cost of damage is difficult since relatively few studies have been carried out in Ireland, and national baseline quantitative data are lacking. Deer are protected by legislation in the Republic of Ireland and Northern Ireland and there is no formal deer management policy in Ireland.

Keywords: *Red, sika, fallow, Sitka spruce, deer damage.*

Introduction

Three deer species are widespread on the island of Ireland, red deer (*Cervus elaphus*), sika (*Cervus nippon*) and European fallow deer (*Dama dama*) (Figure 1A–C; Carden et al., 2011). Since 2007 there have been numerous reports of the presence of a fourth deer species, Chinese muntjac deer (*Muntiacus reevesi*), at various locations in Ireland (Dick et al. 2009, Carden et al. 2011). The most up-to-date records of this species are from 2013, occurring in 15 different 10 km^2 grid squares in Ireland (National Biodiversity Data Centre 2013) (Figure 1D).

Red deer are not widely distributed in Ireland and occur primarily in the northwest, southwest and east of the country (Carden et al. 2011). Their origins in Ireland have been recently investigated using mitochondrial DNA and the Kerry red deer population are now believed to be direct descendants of an human-mediated introduction from Britain during the Neolithic period approximately 5,000 years ago (Carden et al. 2012). Whilst all other populations of red deer originate from various recent introductions and translocations to Ireland from various British and other populations, in particular during the 19th century (Whitehead 1960, Whitehead 1964, Carden et al. 2012).

Sika were introduced from Japan during the 19th century by Lord Powerscourt to his estate in Enniskerry, Co. Wicklow and distributed to various estates in Ireland including locations in Counties Kerry, Fermanagh and Down (Powerscourt 1884, McDevitt et al. 2009). It is widely recognised that these animals were subsequently

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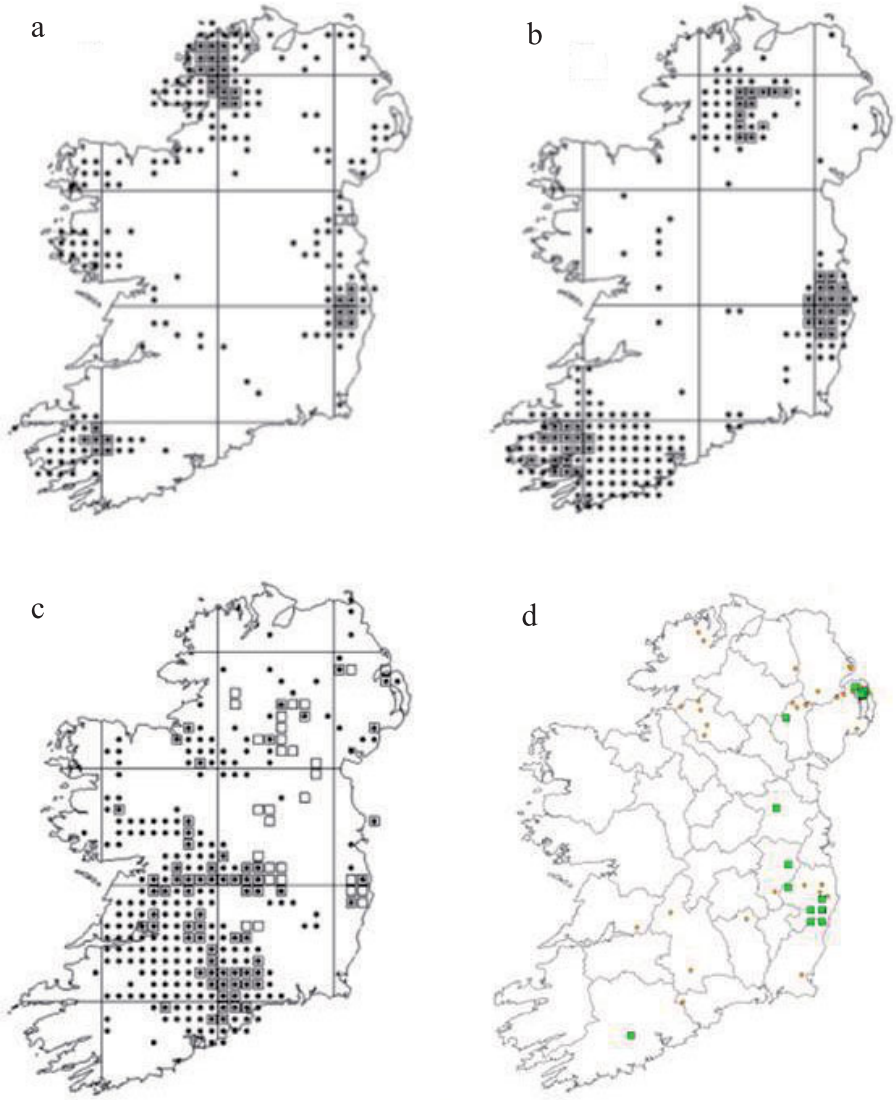

Figure 1: *Taken from Cardin et al. (2011), the distribution of red deer (a), sika deer (b) and European fallow deer (c). Distribution is based on a 10 km square. Each square represents 1,978 records. Dots represent records from 2008. D: Muntjac recordings (d), as of August 2011, were taken from the National Biodiversity Data Centre (2013). Circles represent confirmed sightings and squares represent muntjac deer confirmed as of August 2011.*

released, or escaped, from these estates into the surrounding countryside and became naturalised (Carden et al. 2011). Sika and red deer can interbreed and produce fertile hybrids, and this first occurred on the Powerscourt Estate (Powerscourt 1884) and such hybrids have been detected primarily in the east of Ireland (McDevitt *et al*. 2009).

European fallow deer is the most widely distributed deer species in Ireland (Carden et al., 2011). This species has been in Ireland since its introduction during the 12th century (Sykes 2007) with later translocations in the 18th century (Whitehead 1964). Escapees from enclosed populations through the centuries, particularly in the 20th century, established the species in Ireland (Whitehead 1964).

The overall distribution of the three deer species during a 30-year period (1978 to 2008) show a considerable range expansion: 565% for red deer, 353% for sika and 174% for European fallow deer (Carden et al. 2011). These range expansions relate only to the distribution, but there is less certainty as to the level of increase in the size of the populations (Carden et al. 2011). The method used to survey the distribution recorded only the presence of deer in a 10 km^2 grid square. In general, the distribution of red deer, sika and European fallow deer did not differ from their original reported strongholds originally reported in the 1960s (Whitehead 1960) and the late 1970s (Ní Lamhna 1979). However, red deer are the least widely distributed species in Ireland (Carden et al. 2011). Most of the sika records were found in similar areas of the country, although there were several outlying records which may be a result of illegal translocations (Carden et al. 2011). European fallow deer are the most widely distributed species, although they exhibited the least expansion of all deer ranges during the 30-year period (Carden et al. 2011).

It is difficult to estimate the current population levels of deer in Ireland as national census work has not yet been conducted on Irish deer. Anecdotal reports and media coverage, such as articles in the Irish Examiner by Hickey (2011) and the Irish Independent by Barry (2010), suggest that deer populations are increasing. However, more recently, the Deer Alliance (an assessment committee to oversee the Hunter Competence Assessment Programme (HCAP), a required qualification to shoot deer in Coillte forests in Ireland) reported a significant decline in the deer cull in Ireland for the 2012/2013 season, with approximately 3,000 fewer culled deer compared to the previous season and suggests that there are fewer deer due to excessive poaching (Deer Alliance 2013). However, there are no scientific data available to support this claim. There are few published data regarding deer numbers on the island and recent works noting population trends have not used census data, for example, the population increase noted by Purser et al. (2009) was based partly on numbers of deer shooting licences issued and the annual cull data (deer hunter bag returns based on the deer hunting season) returned by the licenced deer hunters to the National Parks and Wildlife Service (NPWS, within the Department of Environment, Community and Local Government). The numbers of deer hunting licences issued by NPWS have increased every year since 1977, when 231 licences were issued, up to 2012 when 4,501 licences were issued (source: NPWS). According to the annual deer hunter bag returns, for example, from 1997/98 6,173 deer were shot and in 2007/08 24,513 deer were shot according to Carden et al. (2011). There are no data to link the number of deer hunting licences issued to the number of deer present in any given area and therefore, the numbers of deer shot could be a reflection of the number of licences requested rather than a change in deer numbers (Carden et al. 2011). Given these uncertainties, it is important to note that until such time as there are ongoing monitoring programmes of fecundity, birth

rates and natural mortality rates of the deer species and a system that monitors culled deer numbers in Ireland (e.g. a tagging system), the annual deer hunter bag return cull figures cannot be validated, verified, or even calibrated.

Several doctoral and M.Sc. theses have been undertaken on various aspects of deer-related ecology in Ireland, although publications from these theses are limited. Some examples include studies based on the comparative ecology and biology of sika and red deer in relation to woodland habitats within Killarney National Park (Raymond 2008, Burkitt 2009), an examination of the sika cull in Co. Wicklow (O'Brien 2000) and browsing impacts on native woodlands of deer in Glenveagh National Park, Co. Donegal (Höna 2009). No post-graduate research could be found on the impacts of deer on commercial forestry in Ireland.

Use of commercial forests by deer

Red deer, sika and European fallow deer are adaptable species that use a variety of habitats, and are primarily ecotone species that are associated with the woodland edge adjacent to grassland type habitats (Harris and Yalden 2008). Red deer generally prefer upland habitats, heaths, native woodland habitats and conifer plantations (Langbein 1997, Staines et al. 2008). In Ireland red deer are noted for inhabiting treeless habitats and colonising plantation forests (Staines et al. 2008). Sika are typically associated with acidic soils and plantation forests, which may be adjacent to heath (Putman 2008). European fallow deer are associated with mature deciduous or mixed deciduous woodland with an established understory, but will also colonise conifer plantations with some open areas (Langbein et al. 2008).

Afforested habitats, including plantations, are used not only for cover but also provide browse for deer species (Moore et al. 1999, Rooney and Hayden 2002, Scott et al. 2009). Pre-thicket forests in particular provide a variety of conditions for many plant species to flourish. Prior to canopy closure, bramble, grasses and other palatable species grow between the developing trees. The young plantation trees also form a proportion of the diet with the tips of lateral and leader shoots, and bark being edible (Putman and Moore 1998, Scott et al. 2009). Once the canopy closes and the understory is reduced due to lack of light, there is less edible plant matter for deer (Catt and Staines 1987, Latham et al. 1996). Nevertheless, closed canopy continues to provide good cover for daytime refuge (Catt and Staines 1987).

Vulnerability of trees may vary with age and type of tree; for example a pre-thicket age broadleaf tree may be more likely to suffer damage, or mortality, than a thicket age or mature conifer. It is accepted that pre-thicket trees are generally more vulnerable to damage than thicket or mature trees. Broadleaf trees are generally more palatable than conifer trees, but the division between age profile and tree type suggests that forest plantations are vulnerable to deer damage (Table 1). In general terms, the 33.6% of the national crop which approximates to pre-thicket may be more vulnerable than the thicket and mature crops which account for 64.6%. The 24.3% of broadleaf cover may be more vulnerable than the 73.9% of conifer cover (derived from Forest Service (2007) data).

The landscape surrounding a plantation has been found to influence how deer utilise a plantation. For example, in the UK broadleaved plantations surrounded by

Table 1: *Age profile and cover of forests within Republic of Ireland, derived from the National Forest Inventory (Forest Service 2007).*

Age profile	Pre-thicket[a] ≤10 yrs	Thicket 11–30 yrs	Mature ≥31 yrs	Temporarily unstocked	Total % area per land-use
% area of conifer	24.9	34.8	14.2	0.0	73.9
% area of broadleaf	8.7	8.2	7.4	0.0	24.3
% area temporarily unstocked	0.0	0.0	0.0	1.8	1.8
Total % age profile	33.6	43.0	21.6	1.8	100.0

[a] Pre-thicket is generally defined as stands <3 m high, and/or where the canopy has not closed, which usually happens before 10 years, depending on species. The minimum age division in the National Forest Inventory 2007 (Forest Service 2007) was 10 years, i.e. 1–10 years, 11–20 years etc.

arable land were found to be less likely to be damaged by fallow deer than those surrounded by other habitat types (Moore et al. 1999). Additionally, the importance of surrounding habitat as significant foraging habitat has been reported in the UK, for example, deer grazing on grasslands, heaths and agricultural lands adjacent to plantation forests (Catt and Staines 1987, Mann and Putman 1989). No such data exist for Ireland.

Are deer a problem in Irish commercial forests?

It has been recognised that deer can have a negative impact on commercial forests in Ireland (Rooney and Hayden 2002), yet there have been few quantitative studies of the interactions between wild deer and commercial forestry in Ireland. Some work has been conducted on closely related topics such as the effects of deer exclusion on natural habitats (Kelly 2002, Perrin et al. 2006, Perrin et al. 2011) and deer grazing in natural and conservation habitats (Mitchell 1990, McEvoy and McAdam 2005, McEvoy et al. 2006) with additional research which examined various aspects of deer ecology/biology and their browsing habits on conservation habitats, including natural woodlands (for example: Larner 1980, Raymond 2008, Höna 2009, Newman et al. (In Press)).

Two comprehensive reports prepared for semi-state agencies (Campbell and Marchbank 2009, Purser et al. 2009) concluded that deer cause economic damage to commercial forests in Ireland primarily through bark stripping and leader browsing (Figure 2). A report that evaluated the potential financial returns from Sitka spruce (*Picea sitchensis* (Bong.) Carr.), concluded that deer can have a negative effect on commercial timber production (Sweeney and Nieunwenhuis 2008). Elsewhere, many studies from other countries, particularly from Britain, have reported deer damage to commercial forest and agricultural crops (Putman and Moore 1998, Moore et al. 1999, Scott and Palmer 2000, Ward et al. 2008, Scott et al. 2009).

It is difficult to determine if deer are a significant problem in Irish commercial forests due to the lack of suitable quantitative data from across the country. As part

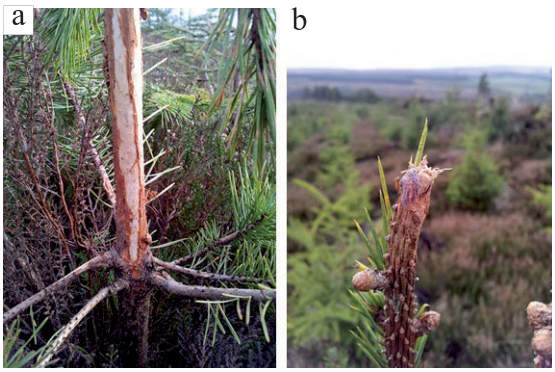

Figure 2: *Example of deer bark stripping to a young lodgepole pine stem (a), and of a Sitka spruce leader shoot browsed by deer (b).*

of an ongoing project on the interaction of deer and commercial forests[1] (Unpublished data; University College Cork 2013) a questionnaire survey of farmers, landowners, hunters, foresters, recreational users of the countryside, and employees of state and semi-state organisations was conducted to judge the public perception of deer. Nearly half (44.5%) of all respondents (1,213 in total) agreed and strongly agreed with the statement that "damage to woodland or forest by deer is a problem" (Figure 3). Clearly the public view is that deer cause damage in forests, but this view cannot yet be substantiated because of the lack of quantitative data.

Damage to trees caused by deer

Bark stripping

Bark stripping by red deer, sika and fallow deer occurs when the bark is stripped

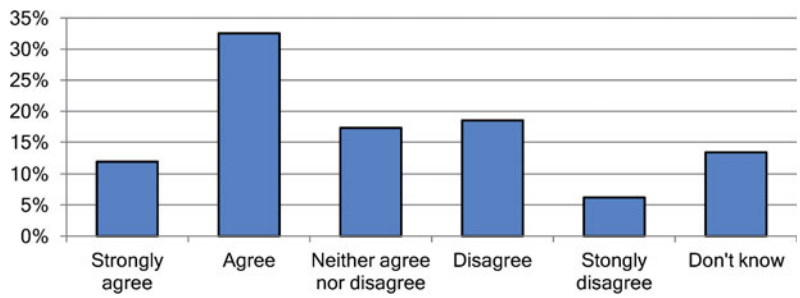

Figure 3: *Results from a stakeholder questionnaire (n = 1,213 respondents) in response to the statement "I think damage to woodland/forests by deer is a problem" University College Cork (2013), unpublished data.*

[1] Unpublished data from a stakeholder consultation survey carried out by the FORDEER research group in 2013, University College Cork.

back to the cambium using the lower incisor teeth to gnaw or strip the bark in an upwards motion (Verheyden et al. 2006) and has been reported to occur when food resources are limited during late winter/early spring (Gill 1992a). Bark stripping may have several negative economic impacts by (i) reducing the value of the timber due to staining of the wood from fungal growth (ii) causing the tree not to grow straight and (iii) excessive bark stripping (ringing of the trunk) and pathogens entering the tree through wounds may lead to the death of the tree (Gill 1992, Gill et al. 2000, Verheyden et al. 2006). An example of bark stripping is shown in Figure 2A.

Sitka spruce is relatively resistant to bark stripping and browsing, while Scots pine (*Pinus sylvestris* L.), oak (*Quercus* spp), larch (*Larix* spp), Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) and Norway spruce (*Picea abies* (L.) Karst.) are more sensitive to such damage (Gill et al. 2000). A seven-year study in Glenbranter Forest, Argyll, Scotland, using the Nearest Neighbour method (developed by Pepper (1998)), concluded that red deer strip bark from 0.5% to 1% of trees per annum, with the amount of damage varying with tree age (Welch et al. 1987). Areas with high levels of bark stripping were identified as "hot spots" (where bark stripped trees are near neighbours), borne out in that 74% of the plots had no observed damage over a two-year period, while in the same timeframe over 10% of trees were bark stripped on 2% of plots (Welch et al. 1987). The survey by Campbell and Marchbank (2009) in Co. Wicklow reported that 60% of sampled plots had wounded trees and 13% of trees were wounded overall.

Browsing

Browsing is the removal of buds and shoots of the tender, palatable, tips of lateral or leader shoots (Rooney and Hayden 2002). One of the main types of damage to plantation forest is that of leader browsing, which affects the growth and development of the tree (Welch et al. 1991, Welch et al. 1992, Scott et al. 2009). Browsing of the leader shoot of Sitka spruce can cause forking which in turn leads to a reduced mean girth when compared to single stem trees at harvesting (Scott et al. 2009). A browsed leader shoot is shown in Figure 2B.

Browsing by deer on the lateral shoots, however, may not always be harmful to the tree. Few impacts are experienced by trees at low lateral browsing levels (Putman and Moore 1998). Low level lateral browsing can stimulate trees to grow faster, and thus may have a positive impact (Putman and Moore 1998). However, severe lateral browsing can have the effect of stunting the growth of trees, or a crop of trees by a year or more (Welch et al. 1992).

Antler damage

Damage also results from antler abrasions on tree branches and trunks, referred to as thrashing and fraying by antlered male deer (Gill 1992), or species-specific damage such as bole scoring by sika stags (Putman 2000). Thrashing and fraying typically impacts younger trees, while bole scoring by sika stags damages the trunks of mature trees (Putman and Moore 1998).

Potential cost of damage in Ireland

A comprehensive study conducted across eight forest plantations (size range 16.7 to 235.8 ha) in Co. Wicklow modelled the potential loss of income from sika damage in Sitka spruce plantations (Campbell and Marchbank 2009). The deer densities in the study area were estimated at 25–40 km^{-2} primarily using the Faecal Standing Crop method post culling (Campbell and Marchbank (2009). Assumptions in the model included a 2008 value of timber at felling, a typical felling programme of 500 ha, and 50% level of bark stripping based on the estimated sika population present in the areas surveyed. It was observed that 60% of the sampled plots had wounded trees and 13% of the trees were wounded overall. The potential loss of income was estimated at approximately €1,200 ha^{-1}. There is, as yet, no available data from other areas of Ireland with which to compare.

Another Wicklow-based study attempted to determine the loss per hectare in a Sitka spruce crop, when only the bottom 2 m of the tree became devalued due to deer damage (Sweeney and Nieunwenhuis 2008). Under a best case scenario of no damage and no fencing, a return of €10,750.78 ha^{-1} was expected, while a scenario of no damage, with the additional cost of fencing had an expected return of €8,779.19 ha^{-1}. This demonstrated that the cost and maintenance of fencing reduced returns by €1,971.59 ha^{-1}. Under a worst case scenario where a damage level of 71% was recorded and no fencing was used, a loss of €459.83 ha^{-1} would be expected with a return of €10,290.94 ha^{-1} (Sweeney and Nieunwenhuis 2008). This may partially explain why fencing is not widely used in Sitka spruce crops when losses without fencing are approximately one quarter of the overall costs of erecting and maintaining fencing. However, the cost benefit of fencing may differ in broadleaf and other vulnerable crops compared with Sitka spruce.

In Ireland, the direct national output value of forestry (before wages, salaries and profits are taken into account) was about €255.4 million in 2003 (Ní Dhubháin et al. 2009). The National Forest Inventory (Forest Service 2007) recorded data from 2004 to 2006, part of which related to deer damage to commercial conifer and broadleaf trees. This national survey recorded 90.8% of trees with no damage, while 0.5% of trees surveyed were recorded as having been damaged by deer bark stripping. This represents 3,205 trees out of the total of 609,008 trees surveyed for the project. This level of bark stripping in Irish forests concurs with results from a similar local study in Scotland where 0.5–1% of trees were bark stripped *per annum* (Welch et al. 1997). Assuming that (a) all damage recorded by the National Forest Inventory was damage recent to the year in which it was recorded, (b) that the tree becomes unusable once damaged, and (c) that deer damage occurred at a rate of 0.5%, and using the figure of €255.4 million representing direct national output in 2003, then deer damage could potentially cost the Irish economy about €1.3 million per year.

It is clear that the available modelling relating to economic impact of deer in Irish forests is heavily based on inbuilt assumptions and were developed using data obtained from only a few locations in Ireland. Lack of quantitative baseline data from across the country is an impediment to estimating the full cost of deer damage.

Legal status and current control measures of deer in Ireland

Red deer, sika and European fallow deer are protected under the Wildlife Act (1976 (Amended 2000)) in the Republic of Ireland and the 1985 Wildlife Order in Northern Ireland. Deer hunting licences are required from National Parks and Wildlife Service or from the Northern Ireland Environment Agency to hunt deer in each relevant jurisdiction on the island of Ireland. A culling season operates within defined dates. Northern Ireland legislation on deer culling season is regulated under the Deer Act (1991) (UK).

Red deer and fallow deer are listed as species of "Least Concern" in the Irish Red List for mammals and sika were not assessed (Marnell et al. 2009). The IUCN lists red deer, sika, fallow deer and muntjac deer as species of "Least Concern" on an international basis (IUCN 2008). However, in a European context sika and muntjac deer are categorised as "Not Applicable" as they were introduced after 1500 AD (Temple and Terry 2007).

At present, there is no national policy on the management of deer in Ireland (Purser et al. 2009). Deer control in Irish forests is undertaken by recreational deer hunters/stalkers who lease deerstalking rights from Coillte (the semi-state organisation, whose remit is the development of commercial forestry in Ireland) and/or gain permission from landowners to shoot on private land. Deer shooting requires a license from the National Parks and Wildlife Service. A further certificate is required of the deer stalkers who shoot on Coillte leases – the HCAP certificate, which is obtained after successfully passing a written examination and shooting competency test by the Deer Alliance. Deer culls are also conducted by Coillte staff and NPWS staff in their respective areas.

The holder of a NPWS deer licence is required to submit a "bag return" of the number, species and sex of culled deer. These data are then compiled by NPWS at the end of each season. As these are the only figures available within Ireland of "deer numbers" annually culled, they are frequently cited in relation to increases or decreases of various deer populations in different counties and nationally. However, such returns cannot be independently validated, and as such, these annual returns must be interpreted with caution.

Forestry companies may choose to enter into sustainable forest management schemes, such as the Forestry Stewardship Council (FSC) or the Programme for the Endorsement of Forest Certification schemes (PEFC). Within Ireland, both of these organisations require management of wild deer (where present) in the forest setting. The FSC requires forest owners and managers to have written deer management plans and to engage with local land owners, stakeholders and statutory authorities, and is designed to be a local or regional deer management plan (FCS 2013). The PEFC requires compliant members to have a written strategy which identifies the management objectives, and also takes account of the relevant licences, including HCAP (PEFC 2013). Both of these are valuable forest managements and accreditation schemes, and recognise the need for deer management, though only at local or regional levels.

Currently there is no national deer management policy, although Coillte recently issued a draft deer-management policy in respect of their estate in which they seek

to maintain deer populations at levels to ensure land use objectives are met, while maintaining deer as part of ecosystem biodiversity, but also controlling any expansion of their range (Coillte 2013). A further policy document has been issued by the Inter-Agency Deer Policy Group outlining the need for a national approach to deer management (Inter-agency Deer Policy Group 2011).

Conclusions

Few direct quantitative and qualitative data are available on the impact of deer on commercial forests in Ireland. Most studies rely on small-scale research projects in localised areas and source information from other countries, particularly from the UK. There is evidence that in some cases deer have had an adverse impact on commercial forestry in Ireland, but limited information is available on the actual or potential economic cost to the forestry industry.

Given the reported problems associated with deer in commercial forests and the stated aim of increasing Ireland's forest cover to 17% by 2030 (COFORD 2009), it is not surprising that a national deer management plan has been widely recommended (Inter-agency Deer Policy Group 2011). The lack of quantitative data regarding both deer densities and the scale of the impacts of deer on commercial trees makes the formulation of an effective national management plan aspirational at present. These knowledge gaps need to be addressed.

Acknowledgements

This study was funded by the Department of Agriculture, Food and the Marine under the National Development Plan 2007–2013. The authors wish to acknowledge and thank Coillte for providing unpublished reports.

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