



The distribution of vascular plant species of conservation concern in Ireland, and their coincidence with designated areas



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ABSTRACT

Protected areas (that are usually designated) play an important role in the effort to halt on-going losses of biodiversity. However, areas outside of designated sites for protection can also hold important elements of biodiversity, and knowledge of their distribution is necessary to ensure effective conservation strategies. We collated and mapped vascular plant distribution data for species of conservation concern on the island of Ireland. For the first time in Ireland, we extracted 6078 distribution records of 176 species of conservation concern and mapped them at the tetrad (2 km × 2 km) scale. We examined the extent to which tetrads with records of species of conservation concern overlapped with designated areas (Natura 2000, Natural Heritage Areas, Areas of Special Scientific Interest). A conservative estimate suggests that many of these tetrads do not overlap with designated areas (in the range of 22–40% for available records). The coincidence of records of individual species with designated areas ranged from 0% to 100% (mean = 79%). The mapped distribution data for all vascular plant species offers guidance to where additional recording may be helpful in supporting conservation activities. The analysis of the distribution of species of conservation concern indicates the importance of both designated areas and the (non-designated) wider countryside for biodiversity conservation. In particular the presence of species of conservation concern in non-designated areas highlights the need for conservation measures outside of designated areas.

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Introduction

Global biodiversity continues to decline (Stokstad, 2010), and of the estimated 350,000 plant species in the world (Paton et al., 2008), 20% are estimated to be threatened with extinction (Brummitt et al., 2008) due to habitat loss, overexploitation, biological invasions, climate change, and pollution (Miller et al., 2012). In response to declining biodiversity the Global Strategy for Plant Conservation (a programme under the Convention on Biological Diversity), has an overall objective of halting the loss of plant diversity (Wyse Jackson

& Kennedy, 2009). The principal strategy for the conservation of biodiversity to date has been to designate areas to shield biodiversity features from threatening processes (Margules & Pressey, 2000). In developed regions, about 11.6% of terrestrial land area has been designated for the purposes of biodiversity conservation, while the global figure stands at about 12.7% (WDPA, 2011). In Europe, the Natura 2000 network consists of Special Areas of Conservation from the EU Habitats Directive and Special Protection Areas from the EU Birds Directive and is the world's largest network of protected areas. This network was proposed in 1992 to ensure the long-term survival of Europe's most valuable and threatened species and habitats (European Commission, 2002).

Although important, protected areas alone are not sufficient to guarantee the persistence of biodiversity (Mora & Sale, 2011), and sites outside of designated areas also contain important components of biodiversity. Such sites can facilitate ecological processes that contribute to the persistence of biodiversity across the landscape (Willis et al., 2012). Habitats of conservation interest outside of designated areas also provide connectivity among sites by creating a more permeable landscape matrix. This in turn helps to buffer habitats and species (both inside and outside of designated areas)

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from the effects of fragmentation such as reduced dispersal and gene flow (Baranyi et al., 2011). The designation of new areas for the protection of biodiversity is not always feasible and habitats associated with vulnerable species could instead be targeted by other conservation measures such as payments for ecosystem services, biodiversity offset schemes and agri-environment schemes. Traditional farming practices in Europe frequently underpin the ecology of many important habitats and species (Polakova et al., 2011), and European landscapes consist of a complex mosaic of important wildlife habitats which occur inside and outside of designated areas. Agri-environment schemes aim to remunerate farmers for environmental protection including biodiversity conservation, and there is a strong policy pressure and opportunity to design more effective and efficient approaches to biodiversity conservation in farmed landscapes (European Court of Auditors, 2011). Thus, there is a strong role for conservation outside of designated areas.

To underpin such actions, knowledge of the spatial distribution of habitats and species inside and outside of designated areas is essential to guide cost-effective conservation strategies. The degree to which designated areas provide cover to the distribution of threatened species has been a focus for research. For example, 88% of Red-Listed plant species in Britain were represented in designated areas; however, 73% of the plant records did not coincide with these designated areas (Jackson et al., 2009). In three regions of Spain, 80–100% of threatened plant species occurred within protected areas (Gomez-Campo, 1997), while 76% of endemic species occurred within protected areas in the Baja California peninsula of Mexico (Riemann & Ezcurra, 2005). In western Norway, 78% of native and 60% of rare species were found within protected areas (Sætersdal et al., 1993). In Madagascar, 78% of the range of Boraginales (an order of flowering plants with many threatened species) was designated (Miller & Morgan, 2011). In Italy, 83% of Important Plant Areas have some legal protection (Blasi et al., 2011) and 8–31% of plant diversity hotspots on the Greek island of Crete coincided with designated areas (Dimitrakopoulos et al., 2004). For the most part these studies report similar levels of cover for threatened species provided by protected areas despite variations in the types and combinations of protected areas involved. In all cases the studies reported that proportions of important plant populations occurred outside of designated areas.

Designated areas can be effective in supporting populations of species; however, where species are poorly represented other methods of conservation outside of designated areas will be required. Our research investigated the distribution of records of plant species of conservation concern, using the island of Ireland as a case study area. For the first time in Ireland, we collated a number of national-scale datasets of records of vascular plant distribution and used them to investigate the following questions: (1) what is the coverage provided by distribution records for all recorded vascular plant species on the island of Ireland?; (2) to what extent does the distribution of vascular plant species of conservation concern overlap with the Irish network of designated areas? (3) Does this distribution reveal a need for conservation measures outside of designated areas? While the study investigates the distribution of vascular plant species in Ireland an assessment of the effectiveness of protection provided to these species within designated areas was beyond the scope of this research.

Materials and methods

Study area

The island of Ireland is located to the west of the European mainland and has a temperate, oceanic climate. The island is divided into two political entities; the Republic of Ireland and Northern Ireland.

Table 1

Sources of distribution records for plant species of conservation concern in Ireland.

Source	Number of records	Number of species
National Parks and Wildlife Service of Ireland	2563	121
Northern Ireland Environment Agency	933	55
Botanical Society of Britain and Ireland	2582	169
Total	6078	176 (distinct species)

This study examines the distribution of vascular plant species of conservation concern (including protected species) that are relevant to the island of Ireland as well as specific categories for plants of high conservation value in the Republic of Ireland and Northern Ireland respectively (see Species of conservation concern subsection).

Data

Species of conservation concern

Plant species on the Flora Protection Order of Ireland (Flora Protection Order, 1999) are afforded legal protection in the Republic of Ireland under the Irish Wildlife Act (Wildlife Act, 1976). Similar protection is afforded to plant species in Northern Ireland as listed on the Northern Ireland Wildlife Order (Wildlife Order, 1985). The Northern Ireland priority species list identifies plant and animal species that are considered to be under threat and in need of conservation action (NMNI, 2013). The Irish Red Data Book of Vascular Plants provides a list of threatened plant species on the island of Ireland (Curtis & McGough, 1988). Species listed in the Red Data book that were classified as not threatened were omitted from analysis. The Red Data Book list applies to the island of Ireland as a whole while the Priority Species list applies to Northern Ireland only. The Flora Protection Order and Northern Ireland Wildlife Order species apply to the Republic of Ireland and Northern Ireland respectively. Where applicable the mapping and analysis of each of these categories of plants was restricted to the different regions of the island. For this study, we have grouped species that have legislative protection together with those species listed on threatened species lists. Collectively we refer to these as 'species of conservation concern' except where it is necessary to refer to the individual categories.

Plant distribution database

Records of species of conservation concern were extracted from tetrad-scale data supplied by the Botanical Society of Britain and Ireland (BSBI) (see Table 1 for details). This represents the most comprehensive vascular plant data at the tetrad scale for Ireland. This dataset was supplemented with records of species of conservation concern extracted from rare plant inventories for the Republic of Ireland from the National Parks and Wildlife Service of Ireland (NPWS) (NPWS, 2012a) and for Northern Ireland from the Northern Ireland Environment Agency (NIEA) (Hunter & Wright, 2011). The spatial resolution of these records varied and only records of tetrad resolution (2 km × 2 km grid cells) or finer were extracted for analyses. All of these data were collated into a plant distribution database together with information on the conservation status for each species.

The data were collected in a non-random manner and with variable recording effort. It is therefore likely that the collection of the data was subject to biases typically associated with the collection of distribution data e.g. preference for sites closer to roads, species-rich sites, or sites of known past species occurrence. The recording effort was not consistent across the island and while many of the tetrads had low numbers of plant species records,

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