Semi-natural grasslands on the Aran Islands, Ireland: ecologically rich, economically poor

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Abstract

AranLIFE is an EU co-funded LIFE project working with farmers in Ireland on the management of semi-natural grassland habitats dependent on agriculture. The farming system, predominantly spring-calving beef cows, has a low herd size, low stocking rate but with a high associated labour input. The poor economic returns and below average policy support payments are resulting in changes in management practices, including a cessation of farming, sub-optimal grazing rates and intensification. These changes have a negative impact on the overall condition of the grassland habitat. AranLIFE is working with 67 farmers to identify the range of management types and associated biodiversity on the farms. Forage analysis indicates that the nutrient content of the grasslands does not always meet the requirements of the grazing animal. This limits the type of suitable livestock systems, with the production of weanling calves and/or store cattle being the main choice. If the farming systems that created these desired habitats are not economically viable, then what are the future prospects of these and similar semi-natural rich grasslands and what support mechanisms are required to ensure their survival?

Keywords: grasslands, AranLIFE, forage quality, policy, grazing, high nature value

Introduction

The three Aran Islands are situated off the west coast of Ireland and contain a mixture of rare European farmed habitat types, classed as priority habitats under the European Habitats Directive. These include Orchid-rich Calcareous grassland (6210), Limestone pavement (8240) and Machair (21AO). Due to the presence of these habitats, over 75% of the total land area is designated as a Special Area of Conservation (SAC). The AranLIFE project (2014-2017), an EU co-funded LIFE Nature project, is working with 67 farmers on the islands. It seeks to develop and demonstrate the best conservation management practices of local farmers. The project includes investigation of the ecological, agricultural and financial context and what policy instruments are required to maintain grassland communities. This work consisted of three main objectives, determining the broad grassland types across the islands, measuring their annual net production and estimating the feeding value of the grasslands. We discuss whether these ecologically rich grasslands can compete in the present policy climate (e.g. Greening under the Common Agricultural Policy) where there is limited differentiation between permanent grasslands that are semi-natural, and intensively managed grassland monocultures.

Materials and methods

A botanical survey of grasslands was carried during 2014 and 2015 based on 77 relevés (4 m²). Data collection methods followed national survey methodologies (O'Neill *et al.*, 2013). All relevés and species were ordinated using Detrended Correspondence Analysis (DCA) using PC-Ord. Classification of the data to establish community types was carried out using two-way indicator species analysis (TWINSPAN). To determine forage quality, samples were collected every two months on 50 sites from March 2015 to March 2016. Samples were analysed for ash, crude protein (CP) (N ×6.25), dry matter, acid detergent fibre (ADF) and neutral detergent fibre (NDF) following

Van Soest *et al.* (1991). Mineral analysis for Ca, P, Mg, Mn, Cu, Fe, Na, Zn and K was determined using inductively coupled plasma-optical emission spectroscopy (ICP-OES) whilst the method for the Heavy metals (Pb, Mo, Se and Co) was Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Primary production was quantified on nine representative sites using movable cages (McNaughton *et al.*, 1996). At each site, three metal exclusion cages of 1×1×0.4 m were located within representative grassland community types. During each sampling period, gross and residual vegetation was clipped to 3 cm within 0.5×0.5 m². Samples were oven-dried to constant weight (60 °C for 48 h) to determine dry matter yield. Cages were moved according to grazing frequency. The Mann Whitney U test was used to test for a significant difference in measured variables between grassland groups.

Results and discussion

Ordination analysis identified four main groups based on the associated vegetation. The grassland communities could be divided into two dominant categories, semi-natural grasslands (SNG) with a high number of species indicative of good quality calcareous grassland (38 relevés), and semi-improved grasslands (SIG) with a lower number of calcareous grassland species and an increase in species more associated with agricultural improvement, specifically nutrient enrichment (39 relevés). When this breakdown of SIG and SNG was analysed for dry matter yield, SIG had yields ranging from 4,136-7,350 kg dry matter (DM) $^{-1}$ yr^{-1} compared with SNG which had yields of 507-2,756 kg DM^{-1} yr^{-1} (Table 1). In terms of minerals, for both grassland categories the forage was deficient in macro- and micro-nutrients, specifically phosphorus, selenium, copper and cobalt (NRC, 2000). These deficiencies were reflected in blood samples taken from the grazing livestock. Phosphorus levels in the SIG were greater than in the SNG. Using crude protein as an indicator of forage feeding value, the SIG showed higher levels than the SNG (Table 1). Furthermore, crude protein values for SIG were above the recommended level for livestock (12% recommendation for good animal performance (NRC, 2000)), but this was not so for the SNG.

Based on this work, the SNG were lower yielding and of poorer feeding value than grasslands with a higher level of agricultural improvement. The poor feeding value also limits the type of stock reared, which is reflected in the predominant enterprise being beef cows with their calves sold as store cattle for finishing in other areas. The nutrition of spring-calving beef cows generally involves feed restriction and mobilisation of body reserves during the winter, and recovery of body reserves during the subsequent grazing season (Murphy *et al.*, 2008).

The CAP policy measures are generally inadequate to (a) pay the Aran farmers a sufficient rate to be economically viable and (b) compete with incentives to convert and intensify wildlife habitats. At present, food production is the main opportunity for the farmers on the Aran Islands to increase their income on existing land, either through improving efficiency and/or increasing output. Existing payments through Pillar 1 are equally available to both intensive agricultural fields and semi-natural grasslands, with no distinction in payment rates. Due to the historic nature of subsidies and low stocking rates associated with

Table 1. Species number per relevé and forage analysis variables (mean ± standard error of the mean) for semi-improved and semi-natural grasslands surveyed on the Aran Islands.[1,2]

Grassland	Species no. per 4 m² relevé	Yield (kg DM ha^{-1} p.a.)	CP (g kg^{-1} DM)	Phosphorus (%)	Selenium (mg kg^{-1})	Cobalt (mg kg^{-1})	Copper (mg kg^{-1})
SIG	23.1±1.0**	5,580±941**	151.3±3.6**	0.27±0.01**	0.09±0.01*	0.05±0.03	7.39±0.44**
SNG	34.6±0.8**	1,760±420**	112.5±2.4**	0.12±0.01**	0.11±0.01*	0.03±0.00	5.39±0.21**

[1] Significance: * $P<0.05$; ** $P<0.01$.

[2] SIG = semi-improved grassland; SNG = semi-natural grassland.

semi-natural grasslands, Pillar 1 payments are lower on the islands, €100 ha^{-1} compared with €262 h^{-1} for the rest of Ireland. Agri-environment payments (Pillar 2) are available to farmers. The present agri-environment programme in Ireland contains grassland conservation options that require the presence of a minimum of three to eight grassland species, and permits a maximum chemical nitrogen application of 40 kg N ha^{-1} per annum and an organic nitrogen limit of 170 kg ha^{-1} (Nitrates Directive limit). In this study, the agriculturally improved grasslands would still meet these criteria, but would not meet favourable condition status under Article 17 of the Habitats Directive reporting. Therefore, a farmer who chooses to maintain the high quality semi-natural grasslands in Ireland will be economically disadvantaged compared with a farmer who chooses to apply fertilisers and intensify production on semi-natural grasslands. Experimental evidence would suggest that a reduction of half of the total number of plant species can be observed with applications between 20 and 50 kg N^{-1} ha^{-1} yr^{-1} (Plantureux *et al.*, 2005).

Conclusions

Intensification of agriculture is limited on the Aran Islands due to their remoteness and designation under the Habitats Directive. Policy incentives and market rewards means that there still is generally an economic advantage to intensification in semi-natural grasslands on the Aran Islands and throughout Ireland that are outside of designated areas for nature protection, as improving grasslands through fertilisation still offers benefits in livestock production terms. The agri-environment schemes directed towards high nature value areas also set a low biodiversity target that is insufficient to save these ecologically rich grasslands that are also economically poor. Results-based agri-environment programmes would offer a much better alternative as the financial payment could be designed to favour the priority grasslands.

References

McNaughton S.J., Milchunas D.G. and Frank D.A. (1996) How can net primary productivity be measured in grazing ecosystems. *Ecology 77, 974-977*

Murphy B.M., Drennan M.J., O'Mara F.P. and McGee M. (2008) Performance and feed intake of five beef suckler cow genotypes and pre-weaning growth of their progeny. *Irish Journal of Agricultural and Food Research 47, 13-25.*

NRC (2000) *Nutrient Requirements of Beef Cattle:* 7th Revised Edition, National Academy Press, Washington, DC, USA.

O'Neill F.H., Martin J.R., Devaney F.M. and Perrin P.M. (2013) The Irish semi-natural grasslands survey 2007-2012. *Irish Wildlife Manuals*, No. 78. National Parks and Wildlife Service, Department. of Arts, Heritage and the Gaeltacht, Ireland.

Plantureux S., Peeters A. and McCracken D. (2005) Biodiversity in intensive grasslands: effect of management, improvement and challenges. *Agronomy Research 3*, 153-164.

Van Soest, P.V., Robertson, J.B. and Lewis, B.A. (1991) Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of dairy science* 74, 3583-3597.