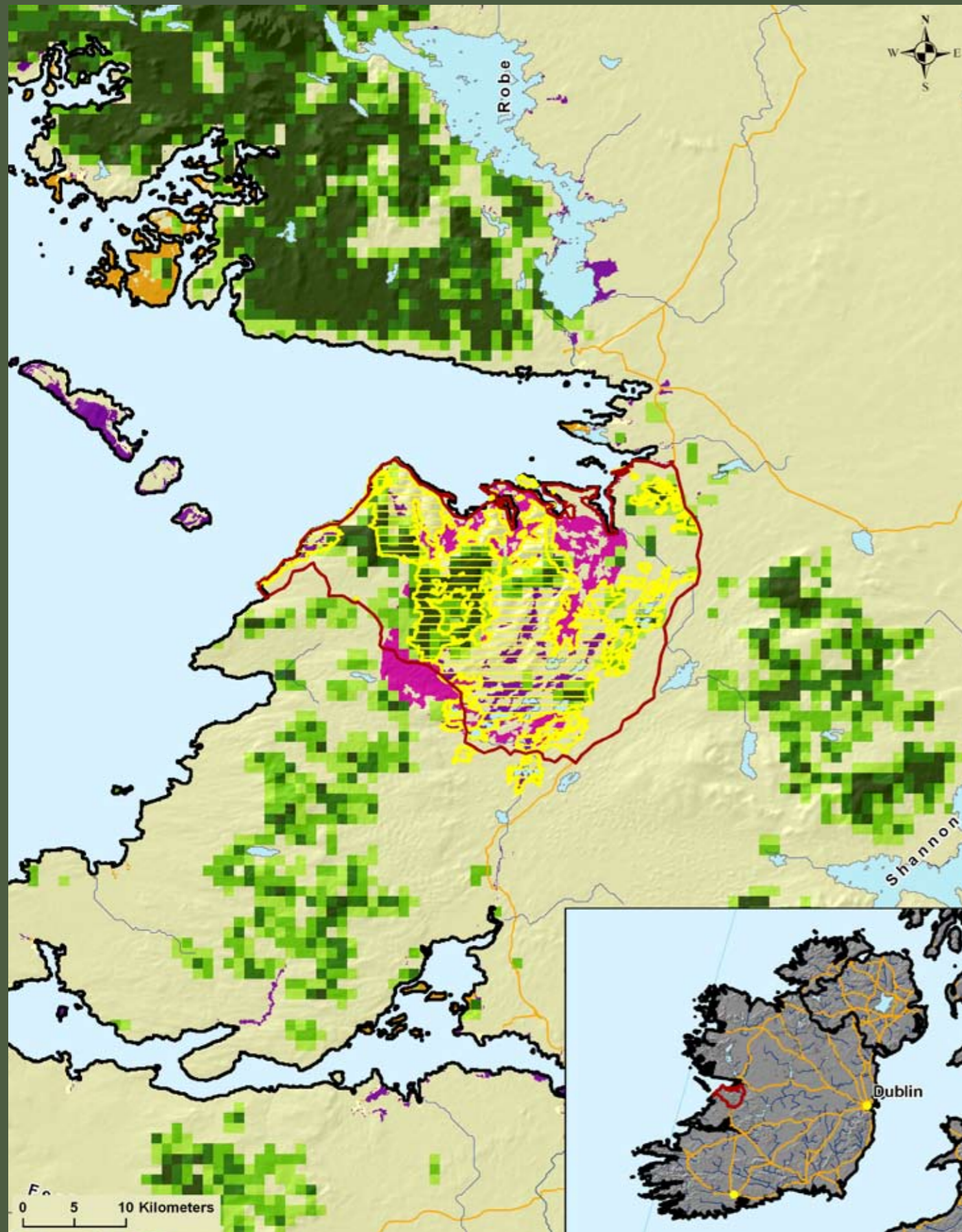


Grasslands of the Burren, Western Ireland

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An intricate mosaic of unique plant assemblages

Although internationally renowned and much visited, few have tried to classify the grasslands of the Burren. One reason for this may be the complexity that results from variations in the micro-topography which can see soil depth and chemistry vary markedly, often at the sub-metre scale. Consequently, different grassland types interdigitate, both with each other and with a variety of limestone heaths, to form an intricate mosaic where the different plant communities change subtly from one to another along a continuum. The situation in the Burren is further complicated as arctic-alpine and northern European species grow alongside southern European and Mediterranean species in unique plant assemblages that do not fit comfortably with existing vegetation classifications.

Karst in an oceanic climate, an invitation for winter grazing

The Burren – derived from the gaelic word *Boireann* meaning ‘rocky place’ – is a distinctive glaciated karst landscape located along Ireland’s mid western seaboard between north county Clare and south-east county Galway. Though there is no clear consensus on the extent of the Burren, the characteristic karst topography extends over approximately 720 km². Once famously described as ‘a country where there is not water enough to drown a man, wood enough to hang one, nor earth enough to bury them’ (O’Dalaigh, 1998), today the Burren is internationally recognised as a haven for both natural and cultural heritage.

Composed of layers of limestone deposited during the Lower Carboniferous (Visean) period (340 m BP) the Burren limestone is underlain by Galway granite and was originally capped by a layer of Namurian shale. This shale cover was stripped away by successive glaciations, surviving only as nunatacks in places such as Slieve Elva (344 m) in the south-west of the region. The Burren has two distinct regions: to the west the ‘high Burren’ where terraced hills reach a maximum altitude of approximately 330 m and to the east, the ‘low Burren’, a flat limestone plain of average altitude 20-30 m. The low Burren contains extensive wetland systems, including oligotrophic lakes, fens and seasonal lakes known as turloughs, the latter a prior-

ity habitat under the EU Habitats Directive (O’Connell, 1994; Drew, 1997; Feehan, 1991).

Considered one of Europe’s finest examples of a karst landscape, the Burren contains over 30,000 ha of limestone pavement as well as an impressive array of other karst features including cave systems, dolines, poljes and microsolutional ‘karren’ features. Mined historically for calcite, phosphate and fluorspar, and more recently subjected to damage from agricultural land improvement and construction (Drew and Magee, 1994), the geological heritage of the Burren nonetheless remains impressively intact. While much of the limestone is exposed or partially covered with thin, free-draining rendzina soils which are unsuited to tillage, areas of brown earth are scattered throughout and more intensive production systems prevail thereon (Finch, 1971). However, as most of the Burren is suitable only for rough grazing, it is a landscape where ‘the cowman and not the ploughman, is king’ (Butler et al., 1985).

Drainage in the Burren is largely subterranean and mainly occurs along a north-south axis. The Burren is particularly sensitive to pollution from agricultural and domestic sources (Drew et al., 1995) and has been designated an aquifer of extreme vulnerability under the Water Framework Directive (<http://www.shannonrbd.com/>). Water availability is very restricted in the Burren due to the karst topography, and this is believed to be one of the key factors in the evolution of the winter grazing systems which continue to prevail in the region. This ‘winterage’ tradition is a unique form of reverse transhumance which sees livestock graze the hills between October and April when water is more readily available, and this has been proven to be a key contributory factor to the ecological wealth of the Burren (Dunford, 2002).

The climate of the Burren is mild with mean daily temperatures (between 1961 and 1990) of 8.9 °C at the meteorological station at Carron (Latitude 53° 02’ N, Longitude 09° 05’ W, Height 155 m). July and August are warmest with mean daily temperatures greater than 14 °C and January and February coolest, with mean daily temperatures less than 5 °C. Rainfall is high, the yearly average being 1525 mm. The wettest months are between October and January with approximately 160 mm of rainfall per month (The Irish Meteorological Service, 2008).

Cultural heritage – the evolution of Burren communities and their landscape

Though scant evidence remains of Mesolithic activity in the Burren, palynological and archaeological studies (O'Connell, 1994) suggest that farming activity first began circa 5,800 BP. The iconic portal tomb of Poul nabrone, dated to 5,500 BP, yielded evidence of an early Neolithic farm economy (Lynch, 1988) while the significant extent of late Neolithic wedge tombs, farmsteads and mound walls suggests that the Burren was densely settled and intensively farmed in the early Bronze Age (Jones, 1998). The subsequent 'Iron Age lull' in activity, accompanied by a resurgence in scrub cover (O'Connell, 1994), is thought to be linked to over-intensive land use, possibly combined with a climatic downturn, resulting in an extensive loss of soil cover and subsequent decline in farming activity (Jones, 1998). The resurgence in farming activity during the early Christian period, including an increase in tillage and in the use of richer lowland areas, is linked to the arrival of Christianity and the introduction of new technologies by religious communities such as Cistercian monks. The large number of ring forts (early Christian period farmsteads) suggests the Burren was well established as an area of significant agricultural activity at this time (McCormick, 1995). One reference from 1317 AD claims that the Burren was 'overflowing with milk and yielding luscious grass' at that time (O'Grady, 1929). During Medieval times the Burren lands were redistributed to English settlers. The 'Book of Survey and Distribution' (Simington, 1641) describes 35 categories of land type within the Barony of the Burren which were further broken down into 121 grades of different value. Under 'pasture' for instance, there are fourteen different classes such as 'Dwarfwood pasture' and 'Rockie pasture' which were further differentiated into 69 subdivisions based on profitability, such as 'Rockie pasture 1/3 profit' and 'Rockie pasture 1/8 profit'. This long-recognised diversity in habitat type and related productive capacity of the Burren remains highly relevant in determining modern-day management systems for the region. In spite of Medieval wars, diseases and famine, the population of the

Burren continued to grow up to the mid-19th century when the great famine occurred. On visiting the region in 1852, a visitor named Coulter stated that a 'fuel famine' had already commenced: 'the people are literally cooking their food with dried fern, heath, brambles, and branches of hazel, of which there is a scanty growth here and there amongst the stone walls which divide field from field' (cited in Ó Dálaigh, 1998).

Protecting the resource: Biodiversity and Conservation Designations

Some 635 (70.5%) of Ireland's 900 native plant species have been found in the Burren uplands (Webb and Scannell, 1983) despite this representing less than 0.5% of the national area. Included among them are 23 of Ireland's 27 orchid species and specialities such as *Gentiana verna*, *Dryas octopetala* and *Neotinea maculata* whose main British and Irish populations occur in the Burren. Other relatively common species such as *Campanula rotundifolia*, *Galium verum* and *Geranium sanguineum* are said to 'flourish so much more exuberantly in the Burren than elsewhere in Ireland' (Webb and Scannell, 1983). The diversity of habitats in the Burren is reflected in the range of its fauna. The flower-rich grasslands, scrub and woodlands are important for butterflies, moths and pollinators such as bees. Indeed, the Burren is recognised as one of the best surviving areas for bumblebees in Ireland (Santorum and Breen, 2005) and is home to at least half of the 570 macro-moths recorded in Ireland and 30 of Ireland's 34 butterfly species. Ireland's only native reptile *Lacerta vivipara*, and the introduced *Anguis fragilis* occur in the area (D'Arcy and Hayward, 1992). One hundred and two bird species have been recorded breeding in the Burren which represents approximately 70% of Ireland's breeding birds. Farmland birds such as *Emberiza citronella*, *Cuculus canorus*, *Pyrrhocorax pyrrhocorax*, *Alauda arvensis* and *Carduelis cannabina* that are declining and becoming increasingly localised in many parts of Europe, can still be found in suitable habitats in the extensive, farmed landscape of the Burren (Lysaght, 2002).

The Burren supports a relatively small number of mammal species. Notable amongst them are: *Lepus timidus hibernicus*, *Sciurus vulgaris*, *Martes martes*, *Meles meles*, *Mustela erminea hibernicus* and *Vulpes vulpes* (D'Arcy and Hayward, 1992) and eight of Ireland's ten bat species including the rare *Rhinolophus hipposideros* (S. Biggane, pers. comm.).

The conservation importance of the Burren is recognised through the designation of over 30,000 ha as Special Areas of Conservation (SAC). Included among the 16 "Habitats" Directive Annex 1 habitats that have been recognised in the Burren are limestone pavement, turloughs, *Juniperus communis* formations on heaths or calcareous grasslands and orchid rich semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*). Much of the north Burren coast is also designated as a Special Protection Area under the EU Birds Directive. Approximately 500 ha are designated National Nature Reserve affording it the strictest protection under the Wildlife Act, 1976 and a further 1,500 ha is state owned National Park.

Burren Grasslands

Ivimey-Cook and Proctor (1966) were the first to provide an account of the main plant communities of the Burren within which they identified several dry grassland types occurring on limestone and drift soils including the *Centaureo-Cynosuretum* and *Festuco-Brometea* (Braun-Blanquet and Tüxen, 1952). Surprisingly little phytosociological research has been carried out since and what has, has often remained unpublished, been concentrated on a relatively small area (Keane and Sheehy-Skeffington, 1995) or been a limited part of a wide-scale classification (O'Sullivan, 1982). A recent study (Parr et al., in press) of Burren grasslands and heaths led to the development of a vegetation classification along the lines of the British National Vegetation Classification (NVC) (Rodwell, 1992). Floristic tables were generated for two grassland communities that are widespread in the Burren and are of significant conservation interest, the *Sesleria caerulea-Breutelia chrysocoma* community and

the *Dactylis glomerata-Holcus lanatus* community. These two grassland communities are differentiated primarily by their species composition but also by their relative agricultural productivity.

Sesleria caerulea-Breutelia chrysocoma community

The *Sesleria caerulea-Breutelia chrysocoma* community, resembles the CG9 (*Sesleria caerulea-Galium sternerii* grassland) of the NVC. They are nutrient-poor calcareous grasslands found on thin soils, are of very low agricultural productivity and are typical of the traditional Burren winterage. This community is usually species rich with a variety of orchids as well as arctic-alpine species such as *Gentiana verna* and *Dryas octopetala*, and Mediterranean-Atlantic species such as *Neotinea maculata* and *Helianthemum oelandicum* subsp. *canum*. This community includes three sub-communities which contain subtle differences which reflect the environmental variation that determines their position along a continuum.

1.1 *The Solidago virgaurea-Hypericum pulchrum* sub-community represents a step in the gradation from calcareous grassland to *Dryas octopetala* heath, the latter species being present but in small amounts. It usually occurs on very thin organic soils or soils that have become leached and contains more species indicative of mildly acidic soils than the other sub-communities.

1.2 *The most calcareous of the sub-communities* is characterised by *Anthyllis vulneraria* and *Plantago maritima*.

1.3 *The Helictotrichon pubescens-Achillea millefolium* sub-community is calcareous but is more mesotrophic and of higher fertility than the other two. This is indicated by the preferential species *Lathyrus pratensis*, *Cerastium fontanum* and *Veronica chamaedrys*. It tends to occur on slightly deeper soils and represents a step along the continuum towards the second type of grassland, the *Dactylis glomerata-Holcus lanatus* community.

Dactylis glomerata-Holcus lanatus community

The *Dactylis glomerata-Holcus lanatus* community is more agricultur-



ally productive and more mesotrophic in character with a higher frequency of agriculturally favoured species than the *Sesleria* grasslands. The nature of the soils in the Burren means that many of these grasslands have a strong calcareous element to their flora and resemble the MG5b (*Cynosurus cristatus-Centaurea nigra, Galium verum* sub-community) grasslands of the NVC but leaching can result in a flora akin to that of the MG5c (*Danthonia decumbens* sub-community). Under Ireland's current agri-environment scheme (the Rural Environmental Protection Scheme- REPS) most of these grasslands are only grazed during the winter but historically, many would have been lightly grazed in the summer as well.

The *Dactylis-Holcus* grasslands also include three sub-communities. Species richness varies between them and whilst they tend to lack the range of 'classic' Burren plants that are present in the *Sesleria* grasslands, they are often rich in orchids particularly those that prefer more moisture such as *Platanthera bifolia*. The three sub-communities are influenced both by ecological gradients and management practices.

2.1 The first sub-community, characterised by *Arrhenatherum elatius* and *Rumex acetosa*, is often found on upland plateaux where the soils are moister and of intermediate fertility. The presence of *A. elatius* as a preferential may reflect the lack of summer grazing on this more productive Burren winterage.

2.2 Another more productive Burren grassland is found on many semi-improved drumlins and in some coastal areas. It is characterised by *Centaurea nigra* and *Anthyllus vulneraria*. Here the flora is influenced by the deeper, often clayey soils which retain more moisture. Whilst generally mesotrophic in nature, leaching means that more species that prefer moderately acid conditions, e.g. *Calluna vulgaris* and *Dactylorhiza maculata*, occur in this community.

2.3 The final sub-community in this group is interesting as its preferences include some species that are constant in the *Sesleria-Breutelia* group but not in the *Dactylis-Holcus* group e.g. *S. caerulea*, *Campanula rotundifolia* and *Thymus polytrichus* along with species associated with more productive or heavily grazed sites such as *Lo-*

lium perene and *Bellis perennis*. This situation appears to demonstrate the impact of summer grazing as all the grasslands that fell into this sub-community were grazed, albeit lightly, for a significant part of late spring and early summer. The result of this is a shift from the *Sesleria-Breutelia* community towards the *Dactylis-Holcus* community.

Winterage the key factor for Burren species

For centuries, livestock have been out-wintered on the grasslands and heaths of the Burren leading them to be known locally as winterages. Store cattle were bought at local fairs in autumn and moved to the winterages where the extensive areas of calcareous grassland and limestone heath provided sufficient winter forage for them. In late April, the animals were moved to more productive summer pastures and the winterages were left fallow or only lightly grazed. This allowed the plants on the winterage to flower and set seed unhindered, thus fostering the species richness and diversity we see today. Winter grazing removes the plant material that builds up over the summer months and without it, many smaller plants would be swamped by the accumulation of dead plant matter leading to their loss, or at least a reduction in their abundance. Thus, the continuation of winter grazing with cattle is an essential part of maintaining the Burren's calcareous grasslands in favourable conservation status. This simplified description of the winterage system does not capture the complexity of the management. Herders were employed by larger landowners to look after stock during the winter months. In return the herders had grazing rights to graze their own stock on these areas throughout the year. Herders would also have use of land around the farmsteads for sowing crops and for summer grazing. As a result, the management systems on each farm would have been a mixture of winter grazing only, summer grazing, year round extensive grazing and small scale rotational tillage.

Over the last thirty years there has been considerable change to the traditional winter grazing systems of the Burren. Changes in market forces and the EU Common Agricultural Policy (CAP) led to farmers

from switching from grazing store cattle (2-3 year old beef steers) on winterages to grazing suckler cows (cows used to produce calves for beef) and to the replacement of traditional breeds with continental crosses. However, suckler cows have higher nutritional requirements than the store cattle they replaced and most of the Burren winterages do not meet these nutritional needs between December and March when the cows are in late pregnancy (Moran et al., 2008). As a result, many farmers have resorted to introducing silage feeding onto winterages or to housing the cows and feeding them indoors. Winter housing of animals has led some farmers to abandon their winterages whilst the introduction of silage feeding has resulted in point source pollution around feeding sites and lower utilisation of winterages. In turn, we see an increase in rank grasses and scrub at the expense of many of the rarer plants such as *Gentiana verna* and orchid species. Many of the mesotrophic grasslands on deeper soils have been reclaimed, fertilised and converted to intensive agricultural grasslands for summer grazing and silage production.

Diminution of grazing and scrub encroachment

The two main threats to the conservation status of the Burren grasslands and their associated fauna and flora are diminution of grazing and scrub encroachment. Reduced grazing levels encourage the development of a layer of dead plant material that chokes out the less robust species and reduces species frequency and diversity over time. Scrub encroachment is a significant problem in parts of the Burren particularly where *Corylus avellana* is spreading on to the orchid-rich grasslands thus compromising their conservation status. In 2003 the cover of dense scrub in the main winterage area of the Burren was measured at 14% but it was suggested that a further 5-10% was affected by early encroaching scrub, particularly *Corylus avellana* (Parr et al., 2006). Without intervention to reverse or slow this encroachment, the future for significant areas of the Burren's orchid-rich grasslands looks bleak.

Threats such as fertiliser application or agricultural improvement are

currently assuaged by the fact that most of the important Burren grasslands are designated SAC and will be protected as long as these designations are in place. However, there are grasslands worthy of conservation outside the designated areas and these continue to be at risk. Little is known about the likely impact of other potential threats to the Burren grasslands such as increased atmospheric nitrogen deposition or the likely impact of climate change. However, increased rainfall and nitrogen deposition would shift the balance towards more competitive species particularly grasses but this may be negated by the high rainfall leading to rapid leaching of the thin soils.

Farming for conservation

The concept of 'farming for conservation' in the Burren emerged from studies by Dunford (2002) and Parr et al. (2006) which suggested that the habitats and heritage of the Burren were under imminent threat from the dual forces of land intensification and marginalisation - pressing threats that are not being addressed by designations under Natura 2000 or National agri-environmental schemes such as REPS. A subsequent application to the EU LIFE-Nature fund facilitated investigation of local solutions to these issues through the 5-year 'BurrenLIFE' project.

The concept of 'farming for conservation' as addressed through BurrenLIFE is based on a few basic principles. The first is partnership, with scientists, farmers, conservation and development authorities working together as equals to realise a common goal - the sustenance of the Burren landscape in which they all have a stake. Another important principle is the adoption of practical local solutions to local problems rather than the adaptation of idealistic generic prototypes for conservation. Another key facet of the BurrenLIFE approach is the rigorous monitoring of the agricultural, environmental and socio-economic implications of proposed land use changes, in order to ensure the delivery of a plausible, holistic model for their wider adoption.

Twenty local farmers are participating directly in the BurrenLIFE



project, covering over 3,000 ha of farmland, 2,485 ha of which are designated as SAC. The farms range in size from 40 ha to over 400 ha and include dairy, suckler beef and mixed (sheep and beef) enterprises. Four of the twenty farms are involved in organic production. On these twenty 'monitor' farms, farming for conservation measures have included simple, but locally popular, ideas based on traditional management practices such as improving livestock access and watering facilities, removing scrub, and restoring internal walls. Innovations have included the development of concentrate feedstuffs which sustain livestock condition while promoting required grazing levels and minimise nutrient input, something existing silage-based supplementary feeding systems have failed to achieve.

Most of the coal-face work of the project has been undertaken by Burren farmers who have shown a significant appetite and aptitude for such conservation work, with the result that conservation resources are deployed within the local community and conservation principles are more readily adopted. The marketing and sale of 'conservation grade' Burren beef and lamb via a local farmer led producers group has also proven highly successful by linking quality local food production and conservation farming. The opportunities presented by this new model of truly 'multifunctional' farming represent a significant departure from the previous six millennia of production-orientated farming activity in the Burren and offer real hope for the future of this threatened landscape.

Case studies

Michael Keane has a mixed farming enterprise of 27 suckler cows and 85 ewes. He farms 198 ha, 10 ha of which is forestry. The entire farm is designated as SAC which includes 155 ha of calcareous fen, limestone pavement and species-rich grassland. Michael sees farming for conservation "as the preservation of a way of life that is fast disappearing in rural Ireland, not alone the unique stone walls, archaeological monuments, rare plants, insects, birds and mammals but also the people whose ancestors have farmed here for generations. It is our wish to hand it on in a healthy state for future generations." Michael also notes "outwintering stock and replacing silage feeding with concentrate means that stock are healthier, fitter and calve easier. Calves are livelier after birth with less risk of disease and scour"

Philomena Hynes farms 35 charolais and limousin cross cows on 140 ha of land near the village of Carron in the central Burren. The entire farm is designated as SAC which includes 120 ha of limestone pavement, heath, species-rich grassland and hazel-dominated scrub. Philomena sees the project as "a very practical scheme for the preservation of the Burren" and "a reflection of the type of farming that was practiced years ago when I was growing up on a farm in Carron. At that time most of the work was done manually and the land was sacred to its owners". She highlights that BurrenLIFE has enabled her "to secure access to part of the winterage for the feeding of concentrates." She hopes "the project will continue after the five year term and that more farmers will be able to partake in it."

Sustainable multifunctional farming

The species-rich grasslands and heaths of the Burren are closely linked with the low-input pastoral systems that have prevailed on these areas for many generations. Their future is equally dependent on the continuation of these systems. These grasslands, in turn, form the basis of the region's other main industry – tourism – and so there are compelling economic and scientific justifications for their ongoing management.

Successive reforms of the Common Agricultural Policy since 1992 have aimed to achieve a balance between competitive agricultural production and a respect for nature and the environment. Today we have an era of single farm payments, decoupling, cross compliance and modulation. Agricultural payments are decoupled from production and conditional on the maintenance of land in good agricultural and environmental condition and the statutory requirements of EU environment, food safety and animal welfare legislation (cross compliance).

More resources are increasingly being made available for rural development which include agri-environmental schemes and nature conservation measures by transferring funds from direct payments, a process called modulation (European Commission, 2007). However, the efficacy of rural development measures to combat issues such as land abandonment and intensification on high nature value grasslands is uncertain. Agri-environment schemes are highly variable and generally not targeted at distinct geographic regions of high nature value (European Environment Agency, 2004).

The implementation of management practices to maintain and enhance the natural and cultural heritage of high nature value grasslands depends on appropriate targeting and locally adapted measures within the wider context of the rural development programmes of member states. The BurrenLIFE model offers a particular opportunity in terms of sustainable multifunctional farming in the Burren; a costed and tested blueprint which has the support of the local farming community. Without such a model in place, Burren grasslands and their custodians face a very uncertain future.

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