

KARST CATCHMENT PROTECTION: THE CUILCAGH MOUNTAIN PARK INITIATIVE, COUNTY FERMANAGH, NORTHERN IRELAND

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Summary

Cuilcagh Mountain, some 20 km south-west of Enniskillen, forms a distinctive ridge profile against the Fermanagh skyline, and is a prominent backdrop to much of the county's lakeland scenery. The summit (667m) is the highest point in the uplands of southwest County Fermanagh and northwest County Cavan, and the summit ridge forms the border between Northern Ireland and the Irish Republic. The mountain is topped by gritstone, exposed in places as dramatic cliffs sweeping down to the lower sandstone and shale slopes which are covered with a thick layer of peat and form one of the best examples of a blanket bog ecosystem in Northern Ireland. Below the sandstones and shales are limestones and the Marbank area supports a fine upland karst which includes the only show cave in Northern Ireland at Marble Arch Caves. In 1990, a general concern over damage to the area's environmental resources, coupled with specific concern over an apparent increase in the magnitude and frequency of flooding at Marble Arch Caves, prompted Fermanagh District Council, as show cave owners, to commission a hydrological and environmental investigation. At an early stage of the research it became apparent that the problems were a result of land use changes in the caves allogenic catchment and that the only way in which effective control of land use could be exercised was through land ownership. Following consultations, the Council identified a key portion of the caves catchment and proposed that it be purchased and established as a natural history park. This marked the start of a major initiative designed both to protect the caves catchment and to protect the blanket bog on Cuilcagh Mountain, a priority habitat under the European Union Habitats Directive. The initiative culminated with the formal opening of the Cuilcagh Mountain Park in June 1999 although work to restore the bog, and to ensure the wider area is managed in a sustainable manner, is ongoing.

Introduction

Approximately half of Ireland is underlain by Carboniferous Limestone (*Fig. 1*) but around 75 % of this is lowland karst much of which is covered by thick superficial deposits such that the limestone has little surface expression. Of the upland karsts, the Burren in County Clare bears a strong imprint of glaciation whereas the northwest plateau karsts, of which Cuilcagh is one, are more typically fluviokarstic (*Williams, 1970*). Cuilcagh Mountain lies some 20 km southwest of Enniskillen in County Fermanagh (7° 48' 17" W, 54° 13' 26" N; *Fig. 1*). Cuilcagh summit (667 m) is the highest point in the county, and the summit ridge forms the border with County Cavan and the Irish Republic. The upper slopes contain a complete representation of the Carboniferous Leitrim Group, some 580m of strata being present. This includes rich fossiliferous sequences containing an outstanding range of goniatites, brachiopods, and other fauna. The spectacular summit gritstone edge and pavement, consisting of the Lackagh Sandstone Formation (also known as the Millstone Grit), is unique in Northern Ireland. The underlying sequences, principally

of sandstone, shales and mudstones, are some 320 million years old and are of Upper Viséan and Lower Namurian ages (Geological Survey of Northern Ireland (GSNI), 1998). The rocks beneath the Leitrim Group are the Dartry Limestone Formation, which has a maximum thickness of 320 m. The Dartry limestone consists of two main lithological divisions, micritic mud mounds and well-bedded cherty limestones. Most of the formation is composed of mud mound accumulations of the Knockmore Member, which form several knoll shaped hills. The well-bedded cherty limestones are best observed on East Cuilcagh where they comprise most of the formation; elsewhere they overlie the Knockmore Member. Underlying the Dartry Limestone Formation is the Glencar Limestone Formation, a shaley limestone which completes the Upper Limestone succession of Co. Fermanagh.

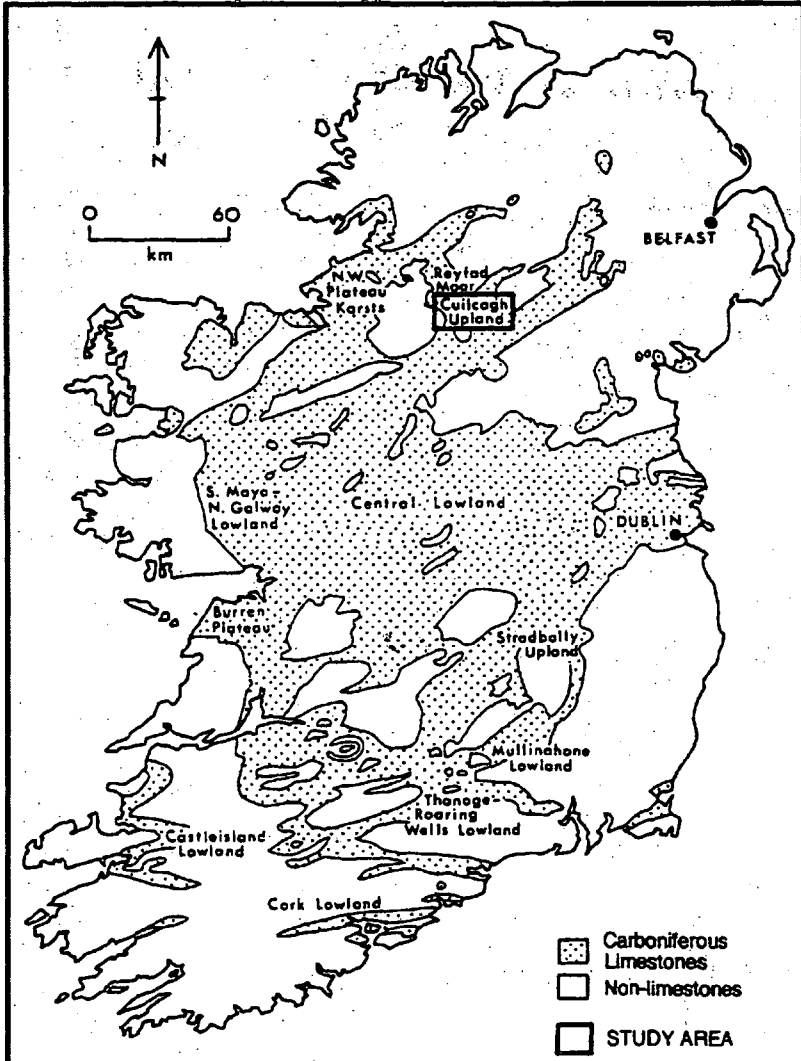


Fig. 1 Limestone areas of Ireland and the location of the Cuilcagh Upland

The border location of the Cuilcagh area has meant that there has been little economic investment, whilst civil unrest during the 1970's and 1980's restricted development of the tourism potential of the scenically beautiful countryside. In an effort to encourage tourism and economic development, Fermanagh District Council (FDC) opened part of the Marble Arch Caves to the public in 1985 and since that time it has attracted over 600,000 visitors from all over the world. Poor soils associated with impermeable boulder clay and a high annual rainfall make agriculture in the uplands unprofitable (in the absence of subsidies), and rough grazing, mainly by sheep, is the major land use. However, in the 1980's Cuilcagh was designated an European Community 'Less Favoured Area' and the availability of agricultural grants and subsidies at a higher rate than for other, more productive, environments led to an increase in stocking density and to sheep being kept on the mountain throughout the year. The peat on the mountain had traditionally been cut by hand for fuel but the 1980's also saw the arrival of machines that made it possible to increase the scale and extent of extraction. Thus, the opening of the caves was accompanied by a marked increase in human activity in their catchment.

During the late 1980's there was a perceived increase in the magnitude and frequency of flooding at the caves and this, together with a general concern over damage to the area's environmental resources, prompted the council to commission a hydrological and environmental investigation. At an early stage of the research it became apparent that, in the absence at that time of any statutory protection for the environment, the only way in which effective control of land use could be exercised was through land ownership. The 1990's saw a series of measures designed primarily to protect the surface environment but also serving to protect the allogenic catchment of the Marble Arch Caves and other caves on the mountain. This paper describes the Cuilcagh environment, the human impacts and the development of environmental protection.

The natural environment of Cuilcagh Mountain

Climate

The climate of Cuilcagh is influenced by the proximity of the Atlantic Ocean, the predominant southwesterly winds bringing in moisture-laden air. As this air passes over areas of high relief, such as Cuilcagh, adiabatic cooling occurs, resulting in condensation and precipitation. Mean annual rainfall increases with altitude from 1270 mm at the Marble Arch Caves to over 2000 mm on the higher slopes and monthly totals range from 10 mm to over 360 mm. The mean annual potential evapotranspiration is c. 570 mm and Walker (1998) found water year runoff totals from a small, essentially natural, catchment ranged from 1230 - 1473 mm over the period October 1993 - September 1996.

Landforms

Although the Cuilcagh upland is best known for its karst there are two other main landform assemblages in the area, the boulder fields and mass movements which characterise the summit area and the peat land of the mid-slopes (*Fig. 2*).

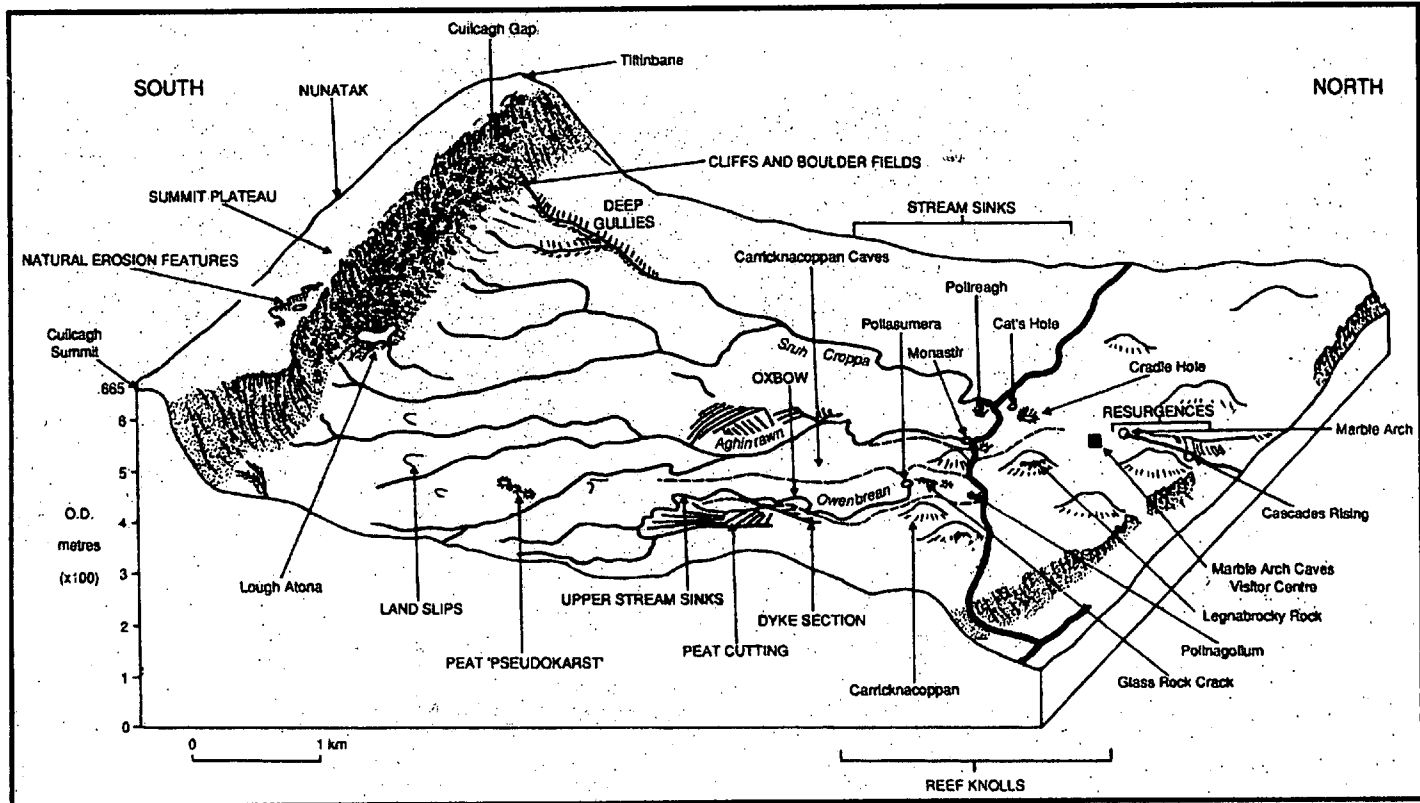


Fig. 2 Landform assemblages on Cuilcagh Mountain

Boulder fields and mass movement

The summit ridge of Cuilcagh Mountain is formed of massive Namurian sandstones and gritstones. The edge of the ridge is characterised by cliffs up to 30 m in height, and in several places large, intact blocks have slid forwards and are separated from the edge by deep rifts. The slopes below are littered with boulders up to 10 m in long axis that are associated with large scale mass movement from the edge of the ridge.

Peat landforms and drainage

The middle slopes of Cuilcagh Mountain are underlain by sandstones and shales with thin interbedded limestones. These are overlain by thin boulder clay deposits which in turn are covered by one to three metres of peat forming one of the best examples of a mountain blanket bog ecosystem in Northern Ireland. Of particular geomorphological interest are the extensive areas of piping and associated pseudokarst landforms including depressions with a long axis of up to 10 m and depths of up to 2.5 m. The majority of the pipes are large features (>20 cm diameter) and contain perennial or seasonal streams which in some cases flow on bedrock floors. They are found both on the gently sloping benches and on the steep slopes at the edge of the benches. Preliminary studies suggest that some have their headwaters in areas of permanent pools on the bog surface and that some at least have formed where peat has grown over the top of small stream channels. *Neild* (1993) has undertaken a study of piping erosion on Cuilcagh but further work is required to determine the extent and nature of the pipe networks and the processes responsible for their formation. In the higher parts of the peat bog there are a number of mass movement features (commonly known as 'bog-flows') which, in the absence of any evidence of past human activities, are presumed to be of natural origin. Rainfall increases with altitude and this may result in greater saturation and higher pore pressures in the peat. Where throughflow lubricates the base of the peat, rotational slumping is likely to result and this is thought to have been the cause of a large flow that occurred in the upper Owenbrean catchment in August 1992 and sent a large body of liquid peat several kilometres downstream and through the Marble Arch Caves (*Walker & Gunn, 1993*). The causes of bog flows on Cuilcagh are currently being studied by *Katie Kirk* (Huddersfield University) as part of a PhD research programme.

Karst landforms and drainage

The sandstones, shales and bog country form the catchment of three large rivers, the Owenbrean, Aghinrawn and Sruh Croppa, which flow down the northern slopes of Cuilcagh Mountain (*Fig. 3*). Each river sinks after crossing onto the limestones and flows through the large and extensive passages of Marble Arch Cave before rising at the head of the Cladagh Glen. The lowest sinks of each river are at Pollasumera, Monastir and Cat's Hole but all three are dry for part of the year, their respective rivers sinking at more recently developed sites some distance upstream. In the case of the Sruh Croppa and Aghinrawn water tracing has shown that the upstream and downstream sinks are associated with the same drainage system, but part of the Owenbrean's flow is captured by the adjoining Cascades catchment via sinks in its bed at c. 500 m and c. 1400 m above Pollasumera (*Gunn, 1997*). Marble Arch cave is the fourth longest in Ireland (c. 6500 m) and some 450 m of it forms the only show cave in Northern Ireland. There are three other

major cave systems on the mountain, Shannon Cave (c. 2500 m), the Prod's Pot-Cascades system (c. 4100 m) and Tullyhona Cave (c. 1500 m), and several other smaller sinks, cave passages and risings (Jones *et al.*, 1997).

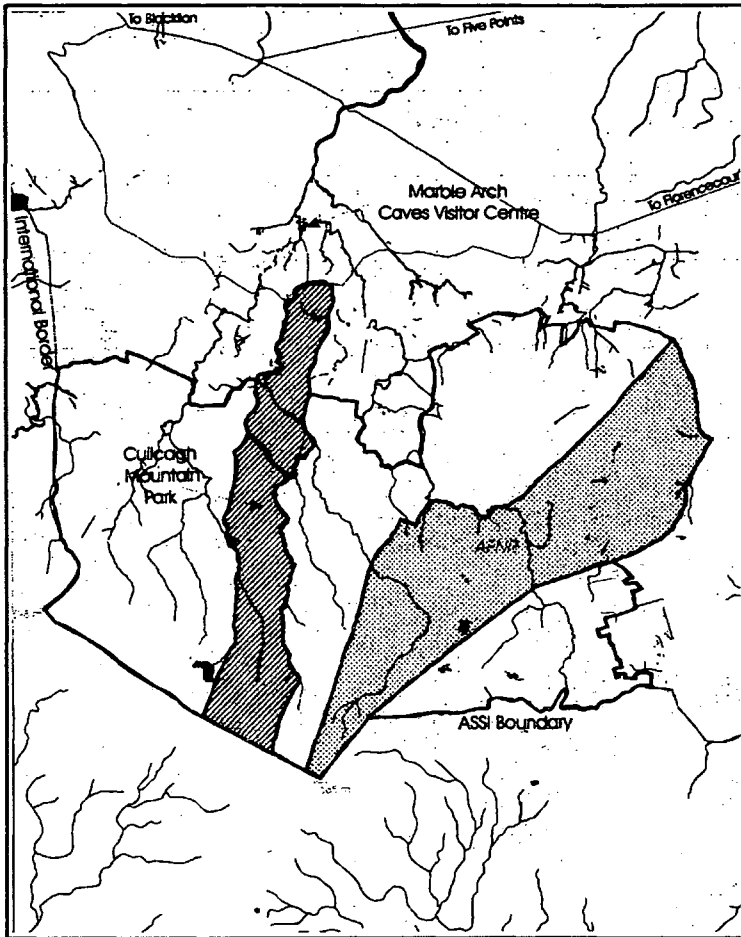


Fig. 3 The drainage of Cuilcagh Mountain and location of the Aghatirourke Forest Nature Reserve (stippled) and Cuilcagh Mountain Park within the ASSI

In addition to the caves, the lower slopes of the mountain are associated with some of the finest examples of upland karst topography in the British Isles (Gunn, 1995). Major sites include the impressive stream sinks of Monastir and Pollasumera at the end of blind valleys, large collapse dolines at Pollreagh and Pollawaddy, a large karst window (Cradle Hole) and the Marble Arch itself, a remnant section of passage isolated by collapse. In addition, there is a series of mud reef knolls and several small areas of limestone pavement. The Dinantian Dartry Limestone Formation has been extensively karstified and there is a complex underground drainage system with over 50 springs (Gunn, 1982, 1997). These include a range of flow types, from short residence-time systems dominated by

concentrated allogenic recharge from sinking streams, to longer residence time springs fed entirely by diffuse autogenic recharge.

Biological Resources

Despite the relative wilderness of much of Cuilcagh Mountain, there are no wholly natural habitats or ecosystems on the surface. Humans have had a marked impact on the vegetation and ecosystems of the area, both through modern land uses, and as a result of more ancient agriculture and settlement. Perhaps the least affected areas are the caves but even those passages which have yet to be entered by humans are likely to have been impacted indirectly by surface activities. The biological interest of the area relates to the size, quality and diversity of the habitats, in addition to the presence of particular plant and animal species of note. The distribution of vegetation types is determined largely by geology, slope, drainage and nutrient conditions. Three broad categories can be identified: the montane grassland of the summit slopes (including a fine example of *Racomitrium* moss heath and a well-developed oceanic montane bryophyte flora); the second largest expanse of intact blanket bog in Northern Ireland covering the gentle middle slopes; and limestone grasslands. The area also supports an important upland bird community, including a significant breeding population of Golden Plover *Pluvialis apricaria*.

Anthropogenic impacts on Cuilcagh Mountain

The Cuilcagh environment has a long history of human-induced change dating back several thousand years to the first land clearance which may have had an influence on the original development of blanket bog. However, during the 1980s and early 1990s there was a marked increase in damaging activities, particularly: land drainage, mechanised peat cutting, burning and increased stocking densities. In addition, physical damage to the surface was identified as resulting from agricultural operations, primarily use of All Terrain Vehicles, and from recreational activities. The primary impacts were on the mid-slopes of the mountain where blanket bog forms most of the caves' allogenic catchment.

Drainage

A number of drainage channels were excavated into the blanket bog during, and possibly prior to, the 1980's. Some were associated with peat cutting but the purpose of others is uncertain. A recent mass movement has been tentatively linked to drainage channel construction (*Dykes & Kirk*, in press) but dip-well measurements in two instrumented catchments (see below) found that the ditches had less effect on the water table than had been expected.

Mechanised peat cutting

The introduction of Scandinavian compact harvesting technology to Ireland in the 1970s revolutionised peat extraction for fuel in upland areas. Chain cutters mounted on large, four wheel drive tractors, allowed cutting of blanket mire in previously inaccessible areas and in areas where hand cutting had been the only option. They were first used on Cuilcagh in the mid 1980s and have affected over 155 ha of which c. 50 ha are currently active and the remainder dormant. The cutover areas vary in size from a few square metres to almost 20 ha and this, together with the intensive nature of the processes involved, means

that the impacts on the environment are diverse and both direct and indirect. None of the cutting has planning permission and it is assumed that the cutting is being undertaken for domestic consumption under existing turbarry rights. The cutting has a profound visual effect and the ecological destruction is equally obvious. However, the hydrological and geomorphological impacts were previously unknown.

To obtain information on the hydrological impacts of mechanised peat extraction on upland blanket bogs a small catchment was divided into two sub-catchments, the upper (c. 302,300 m²) being essentially natural although subject to sheep grazing, while the lower (c. 393,400 m²) was more heavily grazed and included an area of c. 151,700m² from which the vegetation, and with it most of the acrotelm, had been removed prior to machine cutting 4-5 times between 1988 and 1992. Drains, around 1m deep, were installed at 20 m intervals prior to cutting but it was found that they did not significantly alter the water table relative to the control sub-catchment (*Walker, 1998*). Analysis of rainfall and runoff data for the water years 1993-4, 1994-5 and 1995-6, suggests that the total discharge from the cut-over area has been increased by 11 %, mainly due to an increase in winter baseflows (*Walker & Gunn, 1998*). This is linked to the destruction of the vegetation. Peat extraction has dramatically increased peak instantaneous discharge, particularly in summer when peak discharge is more than doubled. The average increase over 148 paired storm events, was found to be 80 %. The response to rainfall events from the cut-over area was quicker and the recession faster, producing an even more flashy hydrograph than that typically seen from peat catchments.

Burning

Burning, like drainage, is associated with agricultural land use, and has been employed extensively on Cuilcagh to improve grazing for sheep, by encouraging regeneration of ageing dwarf shrubs. However, burning can result in severe damage to the bog, particularly to sphagnum species, and results in an increase in storm runoff.

Stocking density

The availability of subsidies, principally headage payments, led to a marked increase in the number of sheep on the mountain, many remaining for the whole year with supplementary feeding in winter. In some areas there was damage to the bog species from overgrazing but a more widespread problem resulted from the wet blanket bog, and particularly the Sphagnum bog mosses, being very sensitive to physical damage by trampling. Consequently a relatively small number of livestock can cause severe damage to the surface of the peat and to the bog vegetation. Cattle cause more damage than sheep but were only grazed over small areas of the mountain. Hydrologically the impacts were accelerated runoff leading to erosion.

Physical damage

Physical damage to the bog results from the concentration of activity in specific areas. In addition to the problems resulting from overstocking, widespread damage has been caused by the use of All Terrain Vehicles, principally small four wheel drive quads, by farmers for access to their land, generally for stock handling purposes. A less significant impact has been localised damage to a long-distance footpath by walkers.

Environmental Protection

Northern Ireland has lagged behind the remainder of the United Kingdom in the protection of sites of biological and earth science interest and in the early 1990's there was no statutory protection of any of the features of scientific interest on Cuilcagh Mountain. General planning law might have given some protection but was not enforced. The reasons for this are beyond the scope of this paper and related to the governance of Northern Ireland, the development of legislation for nature conservation, and the allocation of responsibility for implementing this legislation. The following section briefly describes developments as they relate to Cuilcagh Mountain and the Cuilcagh karst. *Table 1* summarises the chronology of events.

Table 1 Chronology of significant events in the protection of the Cuilcagh environment

Date	Event
1990	Initial suggestion that a Cuilcagh Natural History Park (CNHP) be established.
Feb 1993	Fermanagh District Council (FDC) seek funding from European and other United Kingdom government sources for the purchase of approximately 12 km ² of land to establish CNHP (unsuccessful).
May 1993	West Fermanagh and Erne Lakeland Environmentally Sensitive Area designated by the Department of Agriculture for Northern Ireland (DANI).
Feb 1994	Application made by Royal Society for the Protection of Birds (RSPB), supported by FDC, for Community Financial Aid to support "Conservation of Active Blanket Bogs in Scotland and Northern Ireland". Approved for period Oct 1994 - Dec 1996. Included purchase of land to establish CNHP.
Sept 1994	A portion of Cuilcagh Mountain designated an Area of Special Scientific Interest (ASSI) under Article 24 of the Nature Conservation and Amenity Lands (Northern Ireland) Order 1985.
Feb 1995	ASSI Confirmed.
March 1995	Cuilcagh Mountain ASSI recommended to UK government as a possible candidate Special Areas of Conservation (cSAC). Subsequently included in the list of cSAC submitted to the European Commission by the UK Government. The reason for its inclusion is that Cuilcagh Mountain supports an active blanket bog habitat, identified on Annex I of the EC "Habitats Directive" (92/43/EEC) as a priority habitat.
March 1996	FDC / EHS / DANI commission Strategic Management Review to assist the Council in its aim of conserving the active blanket bog on Cuilcagh Mountain. Review undertaken by Professor John Gunn who put forward proposals for re-orientating the Cuilcagh sub-project.
Dec 1996	LIFE committee accept proposals with minor amendments and approve the re-orientated project for the period to 30 September 1998.
July 1997	As part of the re-orientated LIFE Contract, and with additional financial support from the National Heritage Memorial Fund, the EHS, and the University of Huddersfield, FDC enter into an agreement with Legnabrocky Townland landowner for: a long-term (99 year) lease on c. 28 ha of severely degraded, machine-cut, bog and c. 237 ha of active blanket bog; a 25 year lease on c. 0.7 ha of limestone grassland around Monastir cliff and an access agreement for the area of limestone grassland between the Marbank road and the main leased area.
Dec 1998	Whole of the Cuilcagh Mountain ASSI designated as a Ramsar site under the <i>Convention on Wetlands of International Importance especially as Wildfowl Habitat</i> .
June 1999	Cuilcagh Mountain Park (CMP) formally opened to the public.
April 2000	CMP to be enlarged by addition of Aghatirourke Forest Nature Reserve.

The Cuilcagh Mountain Park

In 1993, a desire to protect the catchment of Marble Arch Caves and the wider Cuilcagh environment led Fermanagh District Council (FDC) to seek funding from

European and other United Kingdom government sources for the purchase of approximately 12 km² of land to establish a Cuilcagh Natural History Park (CNHP). This bid was unsuccessful but in 1994 an application was made to the European Community 'LIFE' Fund by the Royal Society for the Protection of Birds (RSPB), supported by FDC, for Community Financial Aid to support "Conservation of Active Blanket Bogs in Scotland and Northern Ireland". The project, which was approved for the period October 1994 - December 1996, comprised a Scotland Sub-project run by the RSPB and a Northern Ireland Sub-Project run by FDC. The aim of the Northern Ireland Sub-Project was to establish the CNHP, with a primary focus on the conservation of active blanket bog, and through this to protect the allogenic catchment of the caves.

Subsequent to the original bid for funding the West Fermanagh and Erne Lakeland Environmentally Sensitive Area scheme was formally launched (see below), and although this has had many positive benefits it did result in an initial setback for the LIFE project as landowners were unwilling to sell their land at the prices recommended by the District Valuer. As a result FDC were unable to purchase the land necessary for setting up the CNHP, as originally conceived. A Strategic Management Review was commissioned to assist the Council in its aim of conserving the active blanket bog on Cuilcagh Mountain and proposals were made for re-orientating the Cuilcagh sub-project (*Gunn, 1996*). The Council, and the LIFE Committee, accepted these proposals with minor amendments and the re-orientated project was approved for the period to 30 September 1998. In July 1997, as part of the LIFE Contract, and with additional financial support from the National Heritage Memorial Fund, the Environment and Heritage Service, and the University of Huddersfield, Fermanagh District Council entered into a long-term (99 year) lease on 265 ha of blanket bog in the Aghinrawn catchment, including c. 28 ha of severely degraded, machine-cut, bog (*Fig. 3*). The area was included in the original CNHP proposal but to distinguish the new project from that originally proposed it was decided to give the area the title "the Cuilcagh Mountain Park" (CMP). A management plan was prepared (*Gunn & Walker, 1999*) and the Park was formally opened in June 1999.

In 1998, as part the LIFE contract, restoration work commenced on the tract of machine-cut peat in the CMP, the aim being to re-establish a regenerating, self-sustaining bog ecosystem with the appearance and composition of a 'natural' bog. No further peat-cutting is permitted in the Park and the grazing density has been reduced. A track and path have been constructed to provide access to the summit of the mountain and opportunities to observe a range of lithologies and landforms.

The West Fermanagh and Erne Lakeland Environmentally Sensitive Area Scheme

In May 1993 the Department of Agriculture for Northern Ireland (DANI) established the West Fermanagh and Erne Lakeland Environmentally Sensitive Area (ESA) which includes the whole of Cuilcagh Mountain. The scheme is voluntary, farmers within the area being offered a ten year agreement with the opportunity to withdraw after five years if they so wish. Levels of payment are tiered and reflect the conservation value of habitats on the farm. Unfortunately, the specific requirements and particular importance of active blanket bog did not become widely recognised until the mid-1990's and at the time that the ESA scheme was launched they were not well understood. In contrast, there was a widespread concern over the decline in heather moorland and the need for positive management of this habitat. Consequently the blanket bog on Cuilcagh was classified in the

ESA scheme as heather moorland. Properly controlled grazing was seen as the key to successful heather management with DANI prescriptions specifying: (a) a stocking density limit of ten ewes, or one cow, per five hectares, (b) exclusion of stock from November 1st to February 28th. The stocking levels are now considered to be too high for active blanket bog and it is probable that in the future the Scheme will be revised to include a specific 'blanket bog' category with lower stocking levels. Although the ESA Scheme does not have a specific commitment to blanket bog it has been very successful in enhancing nature conservation in general on Cuilcagh and the majority of farmers on the mountain have entered the scheme.

The Cuilcagh Mountain ASSI / SAC / Ramsar Site

In September 1994, some 2745 ha of Cuilcagh Mountain was designated an Area of Special Scientific Interest (ASSI), the designation being confirmed in February 1995 (Fig. 3). The primary selection feature was the blanket bog habitat and the ASSI boundaries were drawn so as to include all active, largely undamaged, bog. Five other selection features were identified for the area: montane heath habitat, oligotrophic lakes, Golden Plover, rare plant assemblage and earth science interest in the exposures on the upper slopes and karst features lower down. In practice the ASSI only encompasses a small part of the Cuilcagh karst but provides protection for a large part of the allogenic catchment. The whole of the ASSI was subsequently included in the list of candidate Special Areas of Conservation (SAC) submitted to the European Commission by the UK Government. The reason for its inclusion is that Cuilcagh Mountain supports an active blanket bog habitat, identified on Annex I of the EC "Habitats Directive" (92/43/EEC) as a priority habitat. The bog extends across the international border and has been included in the list of Special Areas of Conservation (SAC) submitted to the European Commission by the Irish Government. In December 1998 the whole of the Cuilcagh Mountain ASSI was designated as a Ramsar site under the *Convention on Wetlands of International Importance especially as Wildfowl Habitat*. The site qualifies under criterion 1a of the Ramsar Convention by being a particularly good representative example of blanket bog, a globally restricted biotope and under criterion 2a of the Ramsar Convention by supporting an appreciable assemblage of rare, vulnerable or endangered species.

The Aghatirourke Forest Nature Reserve

The Forest Service own the Florence Court Forest Park which includes a large area of land on Cuilcagh. The Aghatirourke Forest Nature Reserve (AFNR), which forms the upper part of the Forest Park, contains c. 25 % of the active blanket bog on the mountain, all of which is within the SAC / ASSI (Fig. 3). Fermanagh District Council has entered into an agreement with the Forest Service to lease the land from April 2000, the intention being that it should be managed, promoted, and form part of, the Cuilcagh Mountain Park.

Discussion

In many karst areas that have substantial allogenic catchments a major difficulty for managers is to find ways to protect the karst from impacts resulting from land use in the allogenic catchment. The reason for this is that while the scientific value of the karst is

usually easy to recognise, the allogenic catchment may have relatively little scientific value and hence not be worthy of protection in its own right. The Cuilcagh karst is therefore unusual in that while the majority of the limestone area has no statutory protection, the allogenic catchment has (Fig. 3). The highest level of protection is given by the Cuilcagh Mountain Park (CMP) where action is being taken to reduce runoff and erosion from the cutover area by a programme of drain-blocking, habitat restoration. Elsewhere in the CMP, and throughout the ASSI / SAC, there is a requirement to enhance the conservation status of the blanket bog and this is being met partly through the controls on stocking density that form part of the ESA scheme. The result should be greater growth of sphagnum and an expansion of the area of flow-bog, bringing the majority of the allogenic catchment back towards a 'natural' condition. However, it is still unsatisfactory that the autogenic catchment, and the caves themselves, have no statutory protection. While the boundaries of the SAC cannot extend beyond the bog, as this is the priority habitat, there is a need for an enlarged ASSI to take in the earth science interest elsewhere on the Mountain. The principal karst landforms on Cuilcagh are limestone pavements, closed depressions (dolines), stream-sinks and caves. An Earth Science Conservation Review (ESCR) of the karst geomorphology of the Cuilcagh / Marlbank area was undertaken by Fogg & Kelly (1995). Some 15 individual 'Units' were identified in five main areas and each could potentially be notified as an ASSI. However, this is akin to trying to identify particular strokes of genius on a large work of art and it is also the case that at least some of the areas outside of the proposed individual ASSI sites form part of the hydrological catchment of those sites that are proposed for designation. Elsewhere in the UK there has been a general presumption against designating karst systems at catchment level, although there is at least one precedent for this approach in the Castleton Caves SSSI, Derbyshire. In the case of Cuilcagh there are large areas of overlap between the existing ASSI and features likely to be included in future earth science ASSI. In addition, much of the area which is of value because of its karst landforms supports limestone grassland, another habitat of Special Scientific Interest. Hence, there is the potential for a large ASSI extending from the Marble Arch Caves to the Cuilcagh summit ridge and covering a wide range of biological and earth science interest. UNESCO are currently considering proposals to establish a Network of GEOPARKS and if a large ASSI were to be designated then it would be a prime candidate for inclusion in the list.

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