BRACKLOON

THE STORY OF AN IRISH OAK WOOD


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BRACKLOON WOOD

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THE STORY OF AN IRISH OAK WOOD

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First published in 2005 by COFORD, National Council for Forest Research and Development, Dublin, Ireland.

ISBN 1 902696 39 5

Title: Brackloon - The story of an Irish oak wood.
Author: D. Cunningham.

Citation: Cunningham, D. 2005. Brackloon - The story of an Irish oak wood. COFORD, Dublin.

Illustrations: Vincent Coleman
Cover design and painting 'Brackloon Wood': Vincent Coleman
Photography: Declan Greene

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RÉAMHFHOCAL

Is acmhainn neamhchoitianta luachmhar iad na coillte dúchasacha atá fágtha in Éirinn. Mhair siad faoi bhagairt go dtí na luathseachtóidí nuair a tosaíodh ar iad a cheapadh ina tearmainn nádúir. San idirlinn cuireadh leis an limistéar seo agus cinntíodh go mbeidh an chuid atá fágtha slán san am le teacht.

Ba chóir gan amharc ar an méid seo, áfach, ach mar thús áite, ní mór cuid mhór oibre idir eolaíoch agus phraiticiúil a dhéanamh leis an méid atá fágtha a caomhnú agus a leathnú. Tá dhá thionscnamh shuntasacha faoi lánseol faoi láthair a chuideoidh le tabhairt faoi na riachtanais seo. Sheol an tSeirbhís Foraoiseachta Scéim na gCoillte Dúchasacha i 2001, a bhfuil mar chomhaidhmeanna aici coillte a chaomhnú agus a leathnú. Ag an am céanna thosaigh Dúchas, Seirbhís na bPáirceanna Náisiúnta agus Fiadhúlra mar atá anois, ar shuirbhé náisiúnta ar na coillearnacha dúchasacha. Ní mór maoiniú a chur ar fáil don obair seo san am le teacht ionas gur féidir méid iomlán na hacmhainne atá fágtha a chinntiú.

Ar aon dul leis an obair suirbhéireachta, tá an fiosrú eolaíoch ar choillte dúchasacha atá chomh tábhachtach céanna maidir le tacaíocht a thabhairt do chaomhnú agus úsáid chiallmhar. Ar na príomhfhoirne atá gníomhach sa limistéar seo tá Grúpa Taighde Éacachóras na Foraoise ag Coláiste na hOllscoile, Baile Átha Cliath. Bhíodh a chuid oibre bunaithe go príomha ag Brackloon.

Ar dtús is é a bhí i gceist ná na hinchuir cheimiceacha a thomhas i bhfearthainn agus ceo, agus a gclaochlú agus úsáid agus iad ag bogadh trí na codanna difriúla den éacachóras. Leathnaíodh an obair seo leis na suirbhéanna ar phlandaí agus ainmhithe a thabhairt isteach le pictiúr níos iomláine a thabhairt den dóigh ar oibrigh na coillte. I 2001, d'fhoilsigh COFORD tuarascáil achomair de ghnéithe eolaíocha na hoibre i *Dianmhonatóireacht ar choillearnach dara in iarthar na hÉireann – Forbairt ar Líonra Monatóireachta Éaceolaíoch.*

Tá coillte dúchasacha iarmharacha mar Brackloooon níos mó ná iarsmaí de na coillte móra a bhí ann fadó – tá gné sóisialta agus stair úsáide leo a thugann a gcarachtar speisialta dóibh. Baineadh tréanúsáid

as cuid mhór acu san am atá thart le haghaidh adhmaid agus gualaigh: ag Brackloon cruthaítear sin ag sraith ghualaigh atá le fáil san ithir. Tá lios agus fulachta fiadh ann chomh maith a chruthaíonn go raibh daoine ag cur fúthu sa choill ag dáta luath.

Le hoibríochtaí a rinneadh ar na mallaibh, baineadh na crainn bhuaircíneacha as de réir a chéile agus cuireadh speicis dhúchasacha leathanduilleacha isteach ina n-áit, d'fhonn coillte dúchasacha a dhéanamh den cheantar ar fad. Tá moladh tuillte ag réchonn Coillte agus iad ag seasamh an fhóid ar son an athraithe seo, agus gan dabht déanfar an rud céanna in áiteanna iele ar fud na tír, ag cur le leathnú limistéar na gcoillte dúchasacha.

Tá áthas orainn go raibh ar a chumas ag COFORD bheith ábalta tacú leis an obair a rinneadh leis an fhoilseachán seo a chur le chéile. Beidh a lainseáil, atá ag teacht chomh cóngarach sin don chéadú bliain den fhoraoiseacht in Éirinn, cuideoidh sé le cur i gcuimhne dúinn faoin oidhreacht shaibhir bhitheolaíoch agus chultúrtha a bhaineann lenár gcoillearnacha dúchasacha. Is scéal é a scríobhadh do lucht léite leathan a thuigfidh trína leathanaigh an gá atá le caomhnú agus leathnú leanúnach a dhéanamh ar shócmhainn shárluachmhar náisiúnta.

David Nevins
Cathaoirleach

An Dr Eugene Hendrick
Stiúrthóir

FOREWORD

Ireland's remaining native woodlands are a rare and precious resource. Their existence remained under threat until the early 1970s when they began to be designated as nature reserves. In the interim this area has been augmented and the future of most of what remains has been secured.

This should only be regarded, however, as a starting point, much scientific and practical work needs to be done to conserve and expand what is left. Two significant initiatives are underway at present that will help to address these needs. The Forest Service launched the Native Woodlands Scheme in 2001 which is aimed at the twin objectives of conservation and expansion. At the same time Dúchas, now the National Parks and Wildlife Service, began a national survey of native woodlands. This work needs to be resourced into the future so that the full extent of remaining resource can be determined.

Allied to the survey work is the scientific investigation of native woodlands which is equally important in underpinning conservation and wise use. One of the principal teams active in this area is the Forest Ecosystem Research Group at University College Dublin. Its work has been mainly based at Brackloon.

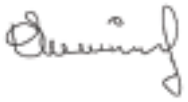
Initially the work involved measuring chemical inputs in rainfall and mist, and their transformation and use as they moved through the different parts of the ecosystem. This work was expanded to include flora and fauna surveys to give a fuller picture of the how the woodland worked. COFORD, in 2001, published a synopsis report of the scientific aspects of the work in *Intensive monitoring of an oak woodland in western Ireland - Development of an Ecological Monitoring Network.*

Remnant native woodlands such as Brackloon are however, more than traces of the great woods of the past - they have a social dimension and a history of use that gives them their special character. Most have been heavily exploited in the past for soild wood and charcoal; at Brackloon a charcoal layer

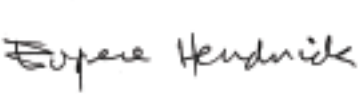
buried in the soil is ample testament to that fact. Early occupation of the woodland is also attested by the prominent ring fort and the presence of *fulacta fiadh*. As Dr Deirdre Cunningham points out Brackloon integrates these uses and changes, and reflects them in the species composition it has today.

Recent operations have seen the gradual removal of the planted conifers and their replacement by native broadleaved species, with the aim of restoring the full area as native woodland. Coillte's foresight in championing this restoration is commendable, and will no doubt be replicated in other areas throughout the country, contributing to the expansion of the area of native woodland.

We are pleased that COFORD has been in a position to support the work that went into the compilation of this publication. Its launch so close to the hundredth year of Irish forestry, will serve as a reminder of the rich biological and cultural heritage that is associated with our native woodlands. It is a story written for a wide audience that through its pages will appreciate the need for continuing conservation and expansion of a priceless national asset.



David Nevins
Chairman



Dr Eugene Hendrick
Director

RÉAMHRÁ

Scaipthe ar fud na hÉireann, in áiteanna iargúlta faoin tuath, tá giotaí de sheanchoillearnach a bhfuil cuma mhothallach tréigthe orthu, beagnach mar a bheadh leisce orainn spás a roinnt leo san oileán. Is iad iarsmaí ár gcoillte dúchasacha iad, a bhfuil nasc acu go minic i gcomharbas caol ach cadránta leis na foraoisí ársa Éireannacha a riaradh ar shaoil ár sinsear.

Tá athrú mór tagtha ar ár saoil féin, chomh maith lenár ndearcadh faoin nádúr. I ndiaidh na mblianta fada de mhí-úsáid a dhéanamh ar ár gcrainn dhúchasacha agus neamhspéis a dhéanamh díobh, tá muid ag teacht chun tuisceana ar a luach arís – ní amháin mar fhoinsí féideartha den chrua-adhmad, ach mar chosantóirí na bithéagsúlachta agus sláinte an phláinéid agus foinsí mórphléisiúir agus tógála croí ag an chine daonna.

Sa bhrú nua náisiúnta chun coillearnacha dúchasacha a thabhairt ar ais agus a leathnú, tá ról speisialta le himirt ag na hiarsmaí atá ann faoi láthair. Tá cúltaca luachmhar acu de speicis plandaí agus feithidí atá de dhíth le héiceachórais leathanduilleacha a athchruthú go rathúil. Agus tá ceachtanna le teagasc acu faoi phleanáil agus bainistíocht bunaithe ar réimse iomlán na n-eolaíochtaí agus ar cheirdeanna adhmaid ar bheag nach ndearnadh dearmad orthu, iad go léir fite fuaite ina chéile.

I bhfara ar chnocáin chreagacha os cionn Bá Clew, tá Coill Brackloon ar na hiarsmaí is mó. Baineadh na crainn bhuaircíneacha nach raibh ag teacht leis an áit amach agus cuireadh spreasáin bheaga ag bun na crainn dara arda 200 bliain d'aois a nascann leis an am atá thart é. Is fada staidéar á dhéanamh air mar choill dara den chineál tipiciúil, ceann tais "Atlantach", raithneach agus crotal ar imill a brainsí, agus is fada í ina lárionad trialach don athchóiriú agus don taighde éiceolaíoch.

Sa leabhar inmholta seo a bhfuil an-eolas le baint as, tarraingíonn Deirdre Cunningham ar an taighde seo le coimpléasc iomlán Brackloon a fhiosrú mar shaol iontach éagsúil de phlandaí agus ainmhithe,

ón ithir chuig na brainsí is airde. Ach an fáth go bhfuil an oiread sin le gnóthú as a cuid oibre ná an dóigh a mothaíonn sí scéal daonna na coille, ag fí fhianaise na ndoiciméad stairiúil trí shága nádúrtha na coille den úsáid agus den athfhás. Léirítear an dóigh a raibh daoine beo i, ar agus thart timpeall ar Brackloon chomh maith leis na hiarsmaí seandálalaíocht, mar an uaimh shaorga agus poill na ndóirí gualaigh.

Is scéal an-spéisiúil agus tábhachtach é scéal Brackloon. Tá sé inste ag Deirdre Cunningham ar dhóigh a mbainfidh éiceolaithe agus gnáthghráthóirí nádúir araon an-sult as, chomh maith le pobal cheantar Chathair na Mart-Louisburgh, nach mór dóibh an choill dara a mheas ina taisce a cailleadh agus a fuarthas arís.

Michael Viney

PREFACE

Scattered across Ireland, in out-of-the-way corners of the countryside, are patches of old woodland with a ragged, left-over look, almost as if we grudged them their space on the island. They are remnants of our native woods, often connecting in slender but stubborn succession to the ancient Irish forests that served the lives of our ancestors.

Our own lives have greatly changed, along with attitudes to nature. After long abuse and neglect of native trees, we are rediscovering their value - not merely as potential stores of hardwood but as guardians of biodiversity and planetary health and sources of great human pleasure and uplift.

In the new national drive to restore and extend native woodland, the existing remnants have a special role to play. They hold a precious reservoir of plant and insect species essential to recreating successful broadleaf ecosystems. And they have lessons to teach about planning and management based on a whole range of interlocking sciences and near-forgotten woodcraft.

Perched on rocky hillocks above Clew Bay, Brackloon Wood is one of the larger remnants, now cleared of trespassing conifers and planted with infant saplings at the feet of the lofty, 200-year-old oaks that connect it to its past. Long studied as a typically moist "Atlantic" oakwood, its branches fringed with ferns and lichens, it has become a national testbed of restoration and ecological research.

In this admirable and deeply-informative book, Deirdre Cunningham draws on this research to explore the whole anatomy of Brackloon as an incredibly diverse world of plants and wildlife, from the soil to the topmost twigs. But what makes her work especially enriching is its feeling for the wood's human story, weaving the witness of historical documents through the wood's natural saga of exploitation and renewal. The extent to which people lived in, on and around Brackloon is also shown by such archaeological remains as its dramatic souterrain and the pits of the charcoal-burners.

The story of Brackloon is a fascinating and important one. Deirdre Cunningham has told it in a way that will appeal to ecologists and ordinary nature-lovers, and to the community of the Westport-Louisburgh area, for whom the oakwood must be reckoned a rediscovered treasure.

Michael Viney

ACKNOWLEDGEMENTS

I wish to acknowledge the kind assistance of the following in the preparation of this book:

Prof. Ted Farrell, UCD, for his guidance, assistance and encouragement throughout this project; Dr Jim Collins, UCD, for his advice and suggestions and providing references and other material; Dr Declan Little, Woodlands of Ireland, for his assistance and comments on an earlier draft of the text; Dr John Feehan, UCD, for valuable comments and suggestions on an earlier draft; Michael Viney, who in addition to providing the preface for the book, read an earlier draft of the text; Prof. Fraser Mitchell and Leo Morahan for providing comments on various sections.

I wish to acknowledge the work of the Forest Ecosystem Research Group, led by Prof. Ted Farrell, and the other researchers who carried out scientific studies at Brackloon over the last decade, from whose reports much material in this book is drawn and which are listed in the bibliography.

I wish to thank the Board of the National Library of Ireland for permission to publish material from the Westport Estate Papers, the Keeper of Manuscripts, Noel Kissane, for permission to access them prior to their being listed, and Brigid Clesham and Wesley Geddis, cataloguers of the papers, for their assistance in locating relevant material.

The illustrations were provided by Vincent Coleman, an architect practicing in Mayo. All watercolors, drawings, photomontage, front and rear cover illustrations are originals for this book.

Photographs were taken by Declan Greene. Additional photographs were provided by Jim Collins, UCD (p.42, 44), Declan Little, (p. 40), Brendan Sayers, National Botanic Gardens (p.53), and the author (p.19, 37 and 58).

Lauren MacLennan, COFORD, prepared the manuscript for publication.

My gratitude is also extended to the following people who contributed in various ways to this project: Julian Aherne, UCD; Gillian Boyle, UCD; Marian Coll, RPS Group, Sydney and Breege Costello, Knappagh; Joe Doyle, Forest Service; the late Jarlath Duffy, Clew Bay Historical Society; Jerry Hawe, Sylviron; Sonia Kelly, Cloona; Catherine O'Reilly, Brackloon NS; Sebastian von Engelbrechten, TCD.

I wish to thank my colleagues in Mayo County Council and my former colleagues in the Forest Ecosystem Research Group in UCD for their support and encouragement.

Finally, I wish to acknowledge COFORD for financial assistance and for seeing this project through all its stages.

Deirdre Cunningham

INTRODUCTION

Brackloon: 'breac' – spotted or speckled, 'cluain' – meadow or pasture

As the Ice Age glaciers started to loosen their grip on Ireland 12,000 years ago, trees gradually began to recolonise the landscape. When the first people arrived over 9,000 years ago, they encountered a country that was extensively forested, and where oak was one of the dominant tree species.

Over the following millennia, clearance for agriculture, occasional outbreaks of disease, lightning-induced fires, exploitation for timber and fuel, and general neglect resulted in the destruction and decline of a once great native forest resource. At the beginning of the twentieth century less than one per cent of Ireland's land area remained wooded. These woodlands are located in hilly, often remote and inaccessible, areas, on infertile acid soils. Their sustainability is of major concern.

Brackloon Wood is a surviving remnant of the original wooded landscape. Situated in the scenic landscape of west Mayo, the wood nestles in undulating terrain on the eastern footslopes of Croagh Patrick, seven kilometres south west of Westport town. The Owenwee River flows along its eastern boundary and meanders its way to Clew Bay, a few kilometres to the north west.

Brackloon is a typical Atlantic oak wood. Its 74 ha support sessile oak, downy birch, ash, wych elm and rowan. Holly and hazel form the understorey. The humid climate and frequent cloud cover assist the growth of the rich flora of shade-tolerant ferns and bryophytes. The epiphyte community is quite remarkable — the boughs of the oak trees are laden with lichens as well as mosses. Some trees have also been colonised by ivy.

The beauty and uniqueness of this area has long been recognised. Early travellers to the region appreciated and remarked upon the allure of the wood and its landscape. McParlan (1802) was especially effusive:

"…In travelling this tract (from Galway) the traveller feels refreshed while passing the extensive woods of the Marquis of Sligo. Woods are everywhere delightful; but one of those in particular the Brackloon Wood, viewed from Davy's-stone-rock, and viewed in such country too, is singularly interesting…"

Thackeray (1842) painted with a somewhat wider brush:

"...And presently, from an eminence, I caught sight not only of a fine view, but of the most beautiful view I ever saw in the world, I think; and to enjoy the splendour of which I would travel a hundred miles in that car with that very horse and driver. The sun was just about to set, and the country road round about and to the east was almost in twilight. The mountains were tumbled about in a thousand fantastic ways, and swarming with people. Trees, cornfields, cottages made the scene indescribably cheerful; noble woods stretched towards the sea, and abutting on them, between two highlands, lay the smoking town…"

Formerly part of Lord Sligo's Westport House Estate, Brackloon Wood was acquired by the Land Commission in the 1940s. It was later transferred to the Forest and Wildlife Service, and subsequently to Coillte (the Irish Forestry Board), the current owner.

The wood has been the subject of various vegetation surveys, attracting several botanical expeditions over the years. During the first Clare Island Survey (1911–13), at least one party visited the wood, during which a wealth of mycological data was collected.

Location of Brackloon.

Part of OS Discovery Sheet Nos. 31 and 38.

Historical surveys are invaluable, not least in the context of comparing species present in the wood today with those recorded in the past, providing an insight into how the vegetation composition of the wood has changed. Ongoing surveys will tell us how it continues to change under current conditions and pressures.

Brackloon Wood did not always look the way it does today. The influence of man on the vegetation has been profound. Throughout its long history the wood has undergone periods of intense exploitation and periods without management of any kind.

Part of the wood was felled and planted with conifers in the 1960s, a practice that was common in many native woodlands around the country at that time. The extant mature oak stand survived this clearance. Now almost 200 years old, these oaks all grew from seedlings and coppice sprouts from trees that had been felled. Today, the main oak woodland comprises an intact area of about 11 ha. Smaller, isolated groups of oak also occur throughout the area.

Brackloon Wood was surveyed by the Forest and Wildlife Service in 1973. At that time only the residual mature woodland was recommended for conservation. However, a subsequent survey almost 10 years later recommended the entire Brackloon property for Nature Reserve Status. In 1999, the wood was finally designated as a proposed Special Area of Conservation (SAC) under the EU Habitats Directive, by the National Parks and Wildlife division of the Department of the Environment, Heritage and Local Government. SACs are prime wildlife conservation areas, considered to be important in a European as well as an Irish context.

Although the woodland had been drastically altered by the planting of conifers in the 1960s, the basic oak woodland structure persisted. It was this surviving native woodland element at Brackloon that first attracted the attention of the Forest Ecosystem Research Group (FERG) in UCD, and resulted in the initiation of ecological studies in the early 1990s.

As the breadth of knowledge regarding the woodland increased, the ecological importance of the oak wood, in spite of its fragmentation, became very apparent. Based on this knowledge, the decision was taken by Coillte to convert the coniferous plantation back to native broadleaved forest, in order to enhance its ecological and conservation attributes. Accordingly, the coniferous stands within the wood were prematurely removed, starting in the mid–1990s.

In the last decade Brackloon has become a key resource for ecological research and for monitoring environmental change. It has become the most intensively studied semi-natural oak woodland ecosystem in Ireland. An extensive scheme of surveying was undertaken in the late 1990s in which all aspects of the woodland ecosystem were studied as part of a long-term monitoring network programme. It was the intention that elements of this survey would be repeated every five to ten years; some of this work has already been carried out. In addition, the vegetation history of the wood spanning the entire

10,000 year period since the end of the last Ice Age has been investigated through pollen analysis and radiocarbon dating. From archaeological studies undertaken within and around the wood, the cultural history of the wood has been elucidated. Brackloon has, in effect, become a living laboratory.

Today, the objective at Brackloon is more than just protection and research; it is also to restore the wood to its former stature and diversity. Since 1998, the wood has been the focus of a planned management programme that has three aims: to restore and conserve the semi-natural status of the entire wood, to ensure the sustainability and longevity of the wood, and to maximise biodiversity (the variety of all living things) within the wood.

The process of recreating the original wooded landscape of Brackloon continues. Most of the planted conifers have now been felled and removed and the wood is being encouraged to revert to its

original composition. Some of the woodland is being left to regenerate on its own, while other clearfelled areas have been replanted with broadleaf trees grown from seed collected at Brackloon. The wood has been refenced and made stock-proof, and the invasive rhododendron has been removed. The long process of restoring and recreating has just begun; to restore the wood to a full mature canopy from its own genetic resources may take two to three centuries to accomplish.

A new chapter in the long history of Brackloon is starting … but first let us go back to its beginnings.

AFTER THE ICE

Twenty thousand years ago Ireland was nearing the end of the last cold stage of a two million year long Ice Age. A thinning blanket of ice covered most of the country, with only the higher mountain peaks protruding here and there. A new landscape remoulded by the ice and its melt waters was gradually emerging.

This periglacial landscape was a harsh and inhospitable place, with arctic-like conditions prevailing. Plants had yet to return from the southerly refuges in which they survived during the icy conditions. There had been plants in Ireland before. During the glacial era there had been a number of glaciations, each followed by a warm 'interglacial' period with its own flora. Successive advances and retreats of the ice cleared the vegetation cover, and quarried, scoured and comminuted the bedrock over which it travelled. Fresh rock debris and older soils and sediments were incorporated into the glacial load. As the glaciers finally retreated, 12-15,000 years ago, this load was deposited to become the parent materials of the soils we have today.

The water locked up in the ice was enough to reduce sea levels to about 120 m lower than they are today. Ireland and Britain were part of the same landmass, which was in turn part of Continental Europe. As the ice melted and the melt waters entered the oceans, sea level rose over a period of a few thousand years. Tracts of dry land that connected Ireland to Britain were submerged and Ireland became an island. There was only a short period of time before the rising seas formed a restrictive barrier to plants and animals making their way to Ireland. Those that had arrived became Ireland's native flora and fauna.

The late-glacial period from 13,000 to 10,000 years ago was characterised by several fluctuations in climate. Only a few hardy species could survive the oscillations in temperature. Those plants that

SOIL DEVELOPMENT

Material deposited by the retreating glaciers has over the millennia been subject to a range of soil-forming processes, resulting in the many and varied soil types that clothe the land today. As soon as vegetation started to gain a foothold in this parent material, soil development, however primitive, had begun. As plants died, their remains were partly decomposed by soil organisms and organic matter or humus built up. Earthworms, and other small animals, mixed the organic material with the underlying mineral soil. This mixed material became the first soil layer, or horizon, which developed. The role of climate in soil formation was also important with temperature and the amount of rainfall affecting the rate of decomposition of organic remains.

As plant residues decay, organic acids are formed. These acids are carried by water percolating through the soil, where they stimulate weathering or breakdown processes. They solubilise some chemicals that are leached from the upper soil body downwards. As weathering proceeds, some primary minerals are disintegrated and altered to form secondary minerals. These newly formed minerals may accumulate where they are formed or may move downward and accumulate in lower soil zones. Soil horizons are formed as materials are translocated or moved from one soil zone to another.

As time went on soil gradually became differentiated into more horizons. Some upper horizons are characterised by the removal of specific constituents, while the accumulation of these or other constituents may characterise the lower horizons. In either case soil horizons are created that are different in character from the original parent material.

Horizons are usually parallel to the ground surface but in some soils they are wavy and undulating. The degree of horizonation is an expression of the kind and degree of soil development that has taken place.

A vertical section through the soil, down to and including any parent material, comprising a sequence of these horizons, is called a soil profile. The profile is the basic unit of study in assessing the nature of any soil. The major horizons that occur in most soil profiles are labelled A (topsoil), B (subsoil) and C (parent material).

returned, as the climate ameliorated, were forced to retreat again when the cold returned. The extreme conditions permitted only the emergence of a sporadic arctic-alpine plant cover, in a landscape in which bare soil still predominated.

Initially, only hardier plants such as algae, lichens and mosses clothed the ground, gaining a foothold in the debris left behind by the melting glaciers. As these early colonisers died and decomposed, their remains (humus) enriched the soils for the next generation of colonising plants. Soon Ireland was covered in meadows of grasses, dock and meadowsweet. This phase ended when the grasslands were invaded by juniper, a short compact conifer, and crowberry.

About 10,000 years ago cold conditions finally came to an end. As the climatic and edaphic conditions progressively improved, forest trees gradually began to recolonise the country. The first tree to gain a foothold was birch, then hazel, followed by pine, oak and elm. Pine was the most common tree on rocky and infertile sites in the west. In fertile regions, elm, ash and oak predominated. Over the period of the next 5,000 years or so, the Irish landscape evolved from open, treeless tundra to one almost completely covered in woodland.

Brackloon Wood: a surviving remnant of our native woodland

Brackloon Wood is a surviving remnant of the original wooded landscape. The wood, however, has not always looked the way it does today. During its 10,000 year history it has undergone many changes, with different trees and plants forming important components of the vegetation at different times. The history of the wood is captured in the sediments of a former lake within the wood.

A large swampy area near the centre of the wood is marked on the Ordnance Survey map as Brackloon Lough. Over the millennia the lake has become in-filled with vegetation. Today, it is a swampy area about 30 m in diameter, dominated by sally (willow). Small areas of open water occur within it. During times of high rainfall the entire area becomes flooded. Sediment cores to a depth of 15 m have been extracted from this area, representing about 10,000 years of accumulation. Pollen analysis of these cores have revealed one of the longest records of post-glacial (or Holocene) vegetation change in Ireland, spanning the entire period from the end of the last Ice Age through to the present day.

Most long sediment sequences in Ireland have been obtained from lakes or bogs and relate mainly to regional vegetation developments. Brackloon Lough is small in area with a restricted pollen catchment with a record that relates mostly to local vegetation history. The restricted area has proven to be invaluable in investigating the relationship between changes in the woodland vegetation and human activity.

RECONSTRUCTING VEGETATION HISTORY

Vegetation development since the end of the Ice Age has been charted using pollen analysis. Plants produce pollen in vast quantities, which depends on wind and animals for transfer from one plant to another of the same species so that fertilisation and reproduction can occur. Most pollen never reaches its intended destination. When it falls on the surface of bogs or lakes it becomes incorporated into the sediments as they accumulate over time. Pollen can be preserved for thousands of years in the acidic peats and lake muds. Most is resistant to decay due to its tough outer coating and because organisms that may destroy the pollen do not occur in strongly acidic environments. When the material in which the pollen is preserved is removed by chemicals in the laboratory, the pollen grains can be studied with a microscope. By extracting a vertical core of sediment from a peat bog or lake and identifying and counting the grains preserved within its many layers, a pollen diagram can be created and a time sequence of the vegetation history of the surrounding area reconstructed.

Pollen incorporated into accumulating bog and lake sediments originates from vegetation from a wide surrounding area. Traditional pollen analyses from these sediments provide reconstructions of vegetation composition on the landscape scale. Irish woods often contain natural hollows filled with peat. Pollen preserved in these peaty hollows is of local origin, providing a record of the vegetation history of the wood itself rather than of the landscape in general.

While the technique of pollen analysis is straightforward in principle, the correlation between the fossil pollen preserved in a sedimentary basin and the vegetation from which that pollen is derived is complex. Some plants produce more pollen than others and their presence can be over represented based on a pollen count. The pollen produced by some plants is lighter than that produced by others and therefore can be transported greater distances, incorrectly suggesting the presence of a particular plant in an area. Also, some pollen grains preserve better than others. All of these factors are considered when interpreting the results of pollen analysis.

ESTABLISHING A TIME SCALE FOR VEGETATION CHANGES

Once the plant species are identified from the pollen analysis, the time when the plants were living can be ascertained. This is done by determining the age of the sediment in which the pollen occurs, using a technique called radiocarbon dating.

Radioactive carbon, C-14, is produced continuously in the upper atmosphere. This unstable carbon becomes mixed throughout the atmosphere and is absorbed by oceans and living organisms. Radioactive carbon is continually decaying but is replaced by new C-14 atoms at a constant rate. The ratio of stable carbon (C-12) to C-14 in the air and all living things at any given time is nearly constant.

As soon as a living organism dies it stops taking in new carbon. The unstable radioactive carbon gradually disappears from the dead remains; only half the radioactive carbon atoms present at any one time will still be radioactive after 5,730 years, the half life of C-14.

The age of the remains is calculated by measuring the proportion of radioactive carbon atoms to the proportion that are not radioactive. The older the sample the fewer radioactive carbon atoms that remain in it. With this technique it has been possible to calculate the ages of many organic remains found in Irish bogs.

In conjunction with pollen analysis and radiocarbon dating, other sources used to reconstruct Brackloon's history include archaeological records and documented historical accounts. Archaeology provides information about settlement patterns from the Neolithic period, through the Bronze and Iron Ages and Early Christian periods. More recent history is gleaned from documentary sources, including estate records and travellers' accounts. Together, these tools give an insight into the role of man in the evolution of Brackloon Wood and in Irish woods in general.

What follows is the story of Brackloon Wood from its beginnings, at the close of the last Ice Age, right through to the present day.

WOODLAND EVOLUTION AT BRACKLOON

The pattern of woodland evolution at Brackloon in the aftermath of the Ice Age broadly mirrors that of the rest of the country. The transition from the late glacial period to the beginning of the Holocene was marked by the expansion of crowberry heath and juniper scrub. This treeless phase lasted until about 10,400 years ago, when the first birch and willow woodland appeared in the locality. Crowberry and juniper disappeared shortly thereafter, probably due to competition from birch. Hazel was the next tree to appear. It invaded the area 10,100 years ago, and within 300 years became dominant locally, displacing the birch and the willow.

Over the following 1,500 years the composition of the woodland vegetation gradually became more diverse with the expansion of pine, elm, Rosaceae (the family to which roses and hawthorn belong), poplar and finally oak. With the diversification of the vegetation came the development of high forest. High forest at Brackloon was at its most pronounced between 9,000 and 6,700 years ago, with oak, elm and hazel the dominant trees. Pine was most abundant between 8,850 and 6,950 years ago, although it does not appear to have been an important tree locally.

As plants and animals colonised the country following the melting of the ice, so too humans began to arrive. The first Mesolithic people came to Ireland over 9,000 years ago and would have encountered an extensively forested landscape. These people were hunter-gatherers, leading a nomadic existence. They used stone, wooden or bone tools in their day-to-day tasks and had no knowledge of pottery making or use of metal. They survived by hunting, fishing and the use of wild plants. Clearance of land for agriculture was a long way away.

The earliest indicator of man's presence in Co Mayo is a Bann flake found in the Urlaur/Kilmovee area in the east of the county. Bann flakes are so named because thousands of these flakes of flint were

recovered along the valley of the River Bann in Northern Ireland, where some of the earliest settlers lived. Many archaeologists believe that these flakes served as all-purpose hunting and fishing knives, and they are associated with the Later Mesolithic period, 7,500–5,500 BP (before present). No evidence of the presence of Mesolithic man has been uncovered in Brackloon or in surrounding areas.

Around 6,000 years ago the climate of Ireland became wetter and warmer than it is today. This climatic shift had major implications for the composition of the vegetation throughout the country. The wetter conditions would have caused loss of soil fertility due to leaching of soil nutrients and would also have resulted in waterlogging. At Brackloon, the first changes in the vegetation, which signalled the beginning of a decrease in local forest cover, occurred around this time. A decline in hazel and elm occurred, in conjunction with an increase in alder. Alder became prominent in swamp vegetation around the margins of Brackloon Lough, probably within a short space of time. The decline in hazel and elm may also be attributed to the consequent deterioration in soil conditions.

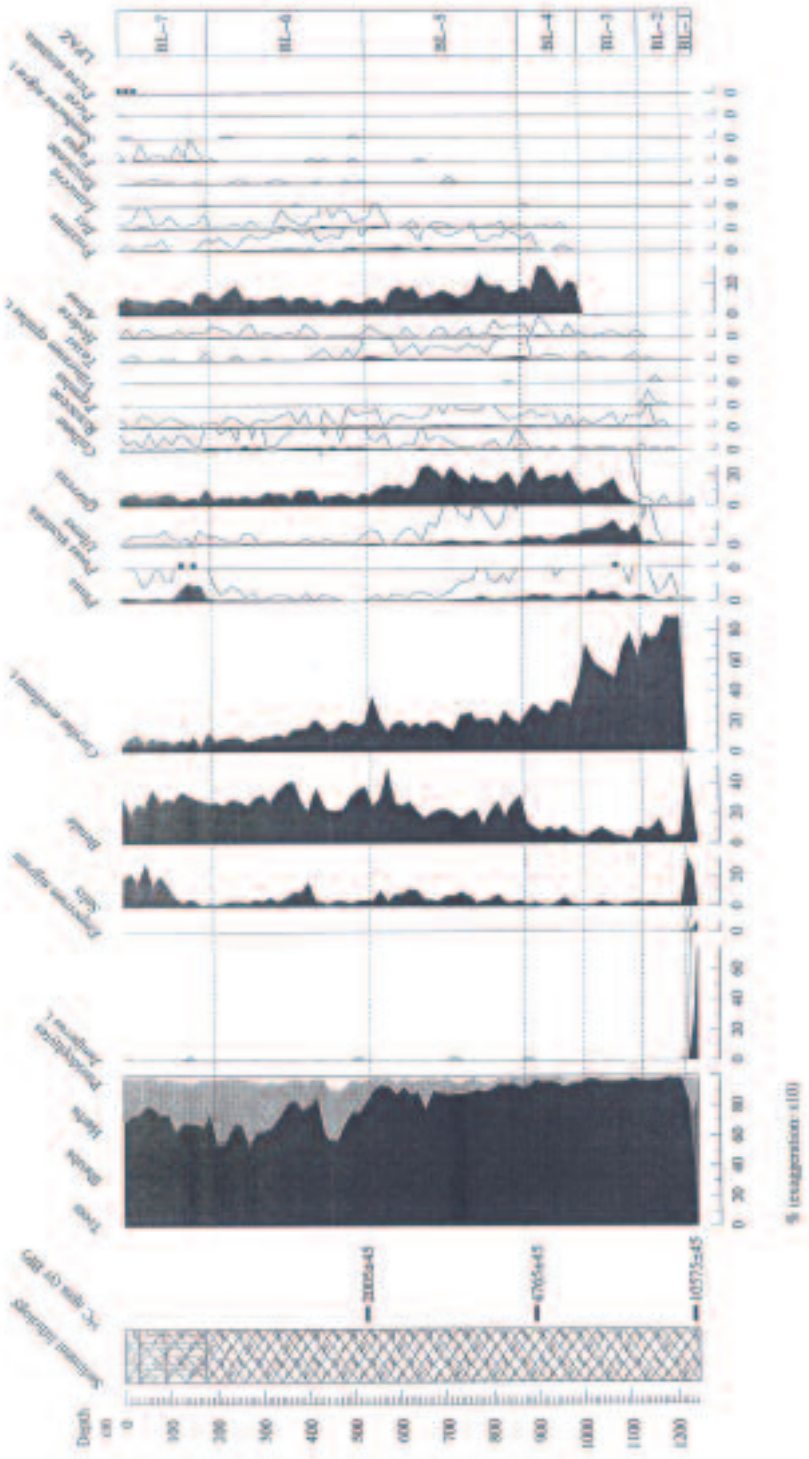
Culturally, the period from about 7,000 to 4,000 BP saw a gradual transition from the nomadic hunter-gatherer existence to a more settled way of life throughout the country, with agricultural practices becoming increasingly important. The first significant human-induced changes in Ireland's vegetation occurred during the Neolithic Period (5,700–4,000 BP), with the arrival of the first farmers. Woodland cover began to decline as trees were cut down to make way for agricultural activity.

A shift in vegetation composition at Brackloon around this time is signalled by the first appearance of ash and its subsequent expansion, coupled with the increased dominance of grasses and plantain and the increase in yew. These species are intolerant of shade, and their arrival suggests that the woodland, which at this time was dominated by oak, became more open in structure.

The expansion of grasses and plantain in the pollen record 5,580 years ago is the first potential evidence for Neolithic activity at Brackloon. The changes in species composition indicate clearance of woodland and a resultant spread in herbaceous vegetation. This clearance was probably associated with animal husbandry rather than arable farming. No cereal pollen was found in the pollen record during this episode, or indeed during any subsequent period, indicating that cereal cultivation was never an important activity at Brackloon.

The area of forest cleared at this time was probably quite small, but the transformation of Ireland's landscape from one that was densely wooded to one almost completely devoid of forest had begun.

The tree that seems to have suffered most at this time was the elm. Its demise is now generally believed to have been caused by disease, possibly similar to what is known today as Dutch Elm Disease. It is noteworthy that the classic 'elm decline', recorded distinctly in pollen records throughout Ireland 5,100 years ago, is not obvious in the Brackloon Lough record. This disease clearly did not affect the elm population at Brackloon, perhaps because it was isolated from other diseased



Pollen diagram based on pollen analysis of Brackloon Lough core.

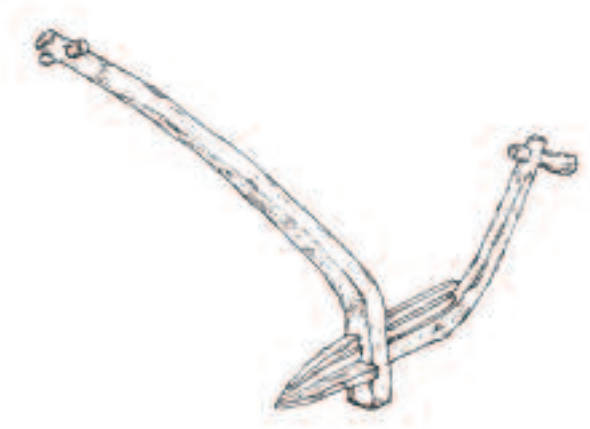
populations. At Brackloon, declines did occur but these were recorded about 1,500 years before and after the general date for elm decline in Ireland.

Ash increased in dominance at Brackloon 4,800 years ago, suggesting that the area was subsequently abandoned, possibly in connection with shifting agriculture. This was followed by a renewed expansion of grasses and plantain, coupled with a decline in elm and hazel. An expansion in birch also occurred, indicating the re-appearance of Neolithic or Early Bronze Age activity in the local area. Grass abundance increased to levels not previously seen and plantain became more common. This would indicate that the local clearances were more extensive in scale and more permanent. However, the simultaneous increase in birch suggests that cleared areas were subsequently recolonised by this tree. A constant cycle of woodland clearance and recolonisation by birch can be envisaged.

Openings or clearings in the forest would probably have been used as grazing areas for domestic animals. They may, however, also have resulted from the local extraction of wood. The increase in human activity suggests a growth in population in the area, although there may not have been fixed local settlements at that time.

Brackloon and its surrounding townlands are rich in archaeological sites, confirming a strong human presence in the area from at least the early Bronze Age. The recent Croagh Patrick archaeological survey, directed by archaeologist Leo Morahan, has revealed further, hitherto unrecorded, evidence of extensive prehistoric settlement in the general area.

Early prehistoric activity is suggested by the presence of impressive cairns on the shoulders of Croagh Patrick. These large burial mounds of earth (tumuli) or stone (cairns) or a combination of both are thought to have their origin in the Late Neolithic/Early Bronze Age.



An ard, an early form of plough.

A pre-bog field system, uncovered in the nearby townland of Owenwee, with its associated circular enclosure, could possibly date from the Neolithic Period. The field system is indicative of community fencing, similar, but on a much smaller scale, to that uncovered at the Céide fields in north Mayo by Professor Seamas Caulfield. We may never know if the initial tree felling at Brackloon in Neolithic times was the work of a few individuals, or a larger-scale co-operative effort.

PEAT DEVELOPMENT

The development of many of our blanket bogs began during the Bronze Age. Organic soils or peats form wherever growth of vegetation exceeds the rate at which it decomposes. Peat usually grows under conditions of almost continuous saturation with water, which curtails movement of oxygen through the soil. Peat initiation is therefore closely linked with soil hydrology and the spread of blanket bog is often attributed to soil deterioration. The removal of trees from the landscape combined with the high rainfall led to waterlogging in many of our soils, resulting in the accumulation of peaty sediments.

As the peat accumulated, stone walls of Neolithic settlements were gradually overgrown and preserved beneath it. Peat cutting has resulted in the discovery of extensive areas enclosed by stone walls. Best documented are the Céide Fields of north Mayo, where the remains of extensive field systems laid out during the Neolithic have been discovered beneath the bog. It is likely that many more of these ancient field systems, which did not have a protective covering of peat, were destroyed during field clearing operations.

The Bronze Age (4,000–2,250 BP) saw a continued assault on Irish woodlands. Bronze Age settlers brought with them a knowledge of metalworking, which they used in the manufacture of tools and weapons. Pollen records from this period indicate that there was an increasing area of land under cultivation and pasture, facilitated probably by the introduction of an early form of plough, or ard, made of wood.

During the period between 4,525 and 2,065 BP there was a further opening up of the woodland cover at Brackloon. Birch, grasses, heather and plantain all increased during this time, coincident with further reductions in hazel, elm and pine. The pollen assemblage from this period suggests the appearance of open areas of pasture, which were recolonised by opportunistic trees such as birch, ash and yew. The expansion of bracken 4,300 years ago most likely occurred on abandoned pasture. These vegetation changes would suggest an increase in human activity.

A mosaic of vegetation types including woodland, scrub and open herbaceous vegetation probably existed in Brackloon at this time. It was then perhaps that the vegetation was at its most diverse, both in terms of species diversity and structure. A constant disturbance regime helped to maintain this

diversity. Thereafter, continuous human impact in the area is evident. Cycles of vegetation clearance and recolonisation by birch lasted until 2,000 years ago.

Archaeological features in and around the wood attest to continual human impact from at least the early Bronze Age. Within Brackloon townland there are what appear to be the remnants of a megalithic structure. Locals referred to a large collection of rocks, 10 m from the edge of the Owenwee River, as a 'giant's grave'. Field clearance in the late 1950s removed them. During the Croagh Patrick Archaeological Survey as many as five *fulachta fiadh* or burnt mound sites were discovered in the vicinity of this possible tomb.

The first definitive (dated) archaeological evidence of permanent human settlement in the Brackloon area comes from a *fulacht fiadh* at Knappagh. Charcoal from this prehistoric cooking site has been dated to 3,000 BP. Many of these burnt mounds have been recorded in the locality, with the majority likely to date to the second millennium BC. Half are situated on or close to the edge of flowing streams or drains, with the remainder on the edge of former turloughs or damp areas. Most examples are fully intact and conform to the familiar horseshoe plan.

FULACHTA FIADH

Associated with Bronze Age or later domestic activity are the many *fulachta fiadh* or burnt mound sites found in abundance throughout the country. These prehistoric cooking sites usually survive as low mounds of burnt and shattered stone and charcoal. They are usually situated beside streams, which provided the water to fill a stone or timber trough. Stones were heated on a nearby fire and placed in the trough to boil the water. Over time, the discarded burnt stones accumulated in a characteristic horseshoe shape around the trough.

A standing stone also occurs within the wood. Standing stones are among the most numerous of the monuments in the area. This irregular stone stands 1.5 m tall, is 1.25 m wide and 0.3 m thick. It is aligned NNE-SSW. Just 32 m to the west of it is a taller stone (1.8 m) of similar width and thickness, tilting to the north east. However, doubts exist concerning their antiquity. In some cases it can be difficult to distinguish a standing stone from naturally occurring stones or those that have been placed as scratching stones for cattle in modern times.

STANDING STONES

Standing stones generally vary from 0.5 m to over 2 m in height. They have been erected since the Neolithic period, but it appears they became popular during the Bronze and Iron Age. The function of standing stones largely remains a mystery, possibly marking ritual or ceremonial sites. Some have been found to mark burials, while others may be territorial markers, or possibly they recorded important places in the landscape where some event took place.

Brackloon Standing Stone.

The Iron Age (300 BC to AD 300) has proven enigmatic for archaeologists; very few artefacts dating from this period have been found in Ireland. An expansion of woodland occurred during this period, with a gradual fading away of evidence of agriculture. Weeds of cultivation disappeared from the pollen record first, followed by cereals. Bracken, grass and plantain also declined. At the same time hazel pollen increased, followed by increases in ash, elm and oak.

Agriculture expanded again dramatically around AD 300. Grass, plantain and bracken rose sharply, accompanied by the reappearance of cereals and weeds of cultivation. Elm and ash fell back from relatively high values and hazel fell markedly.

Dating from this period are the many ringforts, where individual family units dwelt. The remains of these dwellings are visible throughout the Irish landscape today. Their ubiquity indicates a high population density during this period. Clearance of woodland was necessary for agriculture to support this increasing population.

RINGFORTS

Ringforts are the predominant monument type from the Early Christian Period (AD 300–1000) and are the most widespread and recognisable field monument in Ireland. They served as habitation sites for generations. Usually circular in shape (plan), their diameter ranges from 25 m to 50 m. The material used in their construction depends on the local geology or geography. Ringforts enclosed by earthen banks are referred to as raths, while those enclosed by stone are known as cashels. They can have as many as three sets of concentric enclosing banks or walls, thereby increasing the defences. In some cases, especially when there is more than one bank, the earthworks may have been a representation of the wealth or social status of the inhabitants.

Ringforts were constructed as permanent residences and were used when necessary for the temporary housing of livestock. Pastoral farming was the mainstay of Early Christian Ireland, with animals kept principally for milk and hides. Houses took up a variable area of the fort's interior —much of the remainder may have been used to keep animals penned in overnight or during prolonged periods of inclement weather or enemy raids. The earthworks may also have acted as a defence against wild animals. As a general rule of thumb, entrances to the forts are on the side opposite to the prevailing westerly winds. Ringforts are usually located on well-drained land.

View of entrance to the souterrain in the ringfort at Brackloon.

SOUTERRAINS

Souterrains (from the French *sous*, meaning 'under' and *terre* meaning 'earth') are underground rooms cut into the rock or earth, and entered through a narrow opening at ground level. They are often found within ringforts and generally date from the Early Christian period. They are generally believed to have been used as domestic storage areas or as temporary habitations or refuges.

Early Christian Settlement

Human activity in Brackloon was most intense in the period between 2,000 and 700 years ago. Woodland cover was lower during this time than it had been previously and there were many open areas of pasture within the wood. The pollen record shows an increase in the abundance of grasses, plantain, heather and bracken once more, coupled with a decline in hazel, oak, elm and yew. These vegetation changes indicate renewed clearances and perhaps an increase in grazing as suggested, in particular, by the decline in yew, a species intolerant of grazing.

This period of intense human activity, lasting 1,300 years, appears to have had the most severe impact on the local vegetation. An overall increase in human population in the Brackloon area during this time can be envisaged, and perhaps the appearance of permanent settlements locally. The beginning of this period may be contemporaneous with the construction and occupation of the ringfort in Brackloon Wood, the remains of which are still visible today. Indeed, the remains of numerous ringforts in the locality reflect a high concentration of settlement in the area generally during this period.

The dearth of cereal pollen in the local pollen record suggests that the farmers in Brackloon were more concerned with animal husbandry than with arable agriculture. To facilitate more efficient farming practice in a landscape sustaining an ever-increasing population, tree clearing operations must have been widespread at this time.

Located on fairly high ground in the centre of Brackloon Wood, the bivallate, or two-walled, cashel has an internal diameter of 25 m. Both the inner and outer walls survive as collapsed spreads of stone, with an intervening fosse or ditch 2 m wide, with no original facing in evidence. Between the west and north, the spread of stones, which formed the outer wall, is best defined, and here the intervening fosse is also most obvious. The entrance, 2 m wide, is located in the western sector of the ringfort.

A souterrain, known to locals as ‘the cave’, occurs within the cashel. The souterrain is located in the south western sector. It consists of two distinct elements. The first, a passage-cum-chamber reaches 1.2 m high and is 1.5 m wide internally, and contains a small vent at roof level. A narrow ‘creep’ provides access to the second chamber. This chamber reaches 1.8 m in height and 2.5 m in width internally, and contains a well-built alcove in one of its walls. The construction method practised was trenching followed by corbelled building, though some natural stone outcrop forms part of the north and east walls of the second chamber.

Tóchar Phádraig, or (St) Patrick’s Causeway, the Christian pilgrim road to Croagh Patrick, also passes close by Brackloon Wood. It was in use before the arrival of St Patrick. It is believed that the path was originally a major route, capable of carrying wheeled traffic, leading from the seat of the Kings of Connacht at Cruachan, Co Roscommon, to Croagh Patrick, or Cruachan Aigli, as it was known in pre-Christian times.

BRACKLOON IN THE LAST FEW CENTURIES

Woodland cover in Ireland continued to decline over the following centuries of the first millennium AD. There has been much debate over the extent of woodland surviving by 1600. The literature of that period leaves us in no doubt but that significant woodland clearance occurred during the 16th and 17th centuries, chiefly for export as timber and for charcoal production. Writing in 1652, Gerald Boate laid the blame on the English, who "*made great havoc of the woods……did, by degrees, greatly diminish the woods in all places where they were masters*".

At Brackloon, woodland vegetation recovered somewhat around 700 years ago. Grass and plantain declined and beech and pine appeared locally. Pine was particularly abundant from 1400 to 1600. This may have occurred as a result of a decline in local land use, as indicated by the decrease in grasses, plantain, heather and bracken. The local pine wood lasted for about 300 years, after which it was cleared, probably felled for timber or charcoal. At the beginning of this phase, beech, a non-native species, was introduced into the wood.

Many industries used wood or charcoal as fuel. The best documented of these, and perhaps the biggest, was iron smelting. Production of charcoal to fuel local ironworks was unquestionably a major consumer of Irish woodland in the 17th and 18th centuries. An ironworks located at Knappagh, not far from Brackloon, was in operation at that time.

In England, the demand for cast iron was such that prices for timber to make charcoal rose sharply. The demand for charcoal in the Medieval Period had already greatly denuded large areas of forest and, as early as the 13th century, measures had been taken to limit the destruction of the forests. In the 17th century therefore, English iron masters sought alternative sources of timber and Ireland became the focus of their attentions.

CHARCOAL MAKING

Charcoal making was a craft traditionally carried out within woodlands, as charcoal is lighter and easier to transport than the wood from which it is made. Charcoal making usually took place during the summer. The production of charcoal involved the clearance of an area of forest, often near a road or path. The wood was cut into manageable sizes, pieces 0.5 m to 1 m in length, in late winter or spring and allowed to dry for several months. The wood was then transported to the hearth or charcoal production area. Dry low-lying flat areas with convenient access would have been favoured for charcoal production. The wood was arranged vertically and sods placed over and around the heap to restrict oxygen supply. The wood was ignited and allowed to smoulder to expel water and increase the calorific value. It was then transported to the furnace. Approximately 100 tonnes of wood produces 25 tonnes of charcoal.

Charcoal was produced mainly from coppiced timber. Many tree species will coppice when cut down, that is a number of stems will sprout from the cut stump. These stems can be harvested on a rotational basis providing a regular supply of timber. Coppicing as a system of forest management was practised widely in England, and since most of the iron masters were English, would have been known here.

Surviving charcoal hearths in woodlands are usually circular low platforms about 8 m in diameter. Beneath the leaf litter, the flat floor is usually covered with debris of charcoal, from which the species of wood used can be ascertained; mainly oak, hazel and birch. The charcoal present in the soil at Brackloon is residual charcoal that remained on the forest floor and was subsequently buried by soil-forming processes. Relict charcoal hearths are conspicuous in woodlands today by a change in the forest stand structure, a general absence of understorey vegetation and blackened charcoal-rich soil. The microtopography is flat and canopy cover open.

Although wood was plentiful and cheap in Ireland, encouraging the growth of the smelting industry here, there had been no existing tradition of large-scale smelting. The technology was therefore imported by settling English iron makers. Between 1600 and 1800 over 160 iron-making furnaces were known to have existed around Ireland.

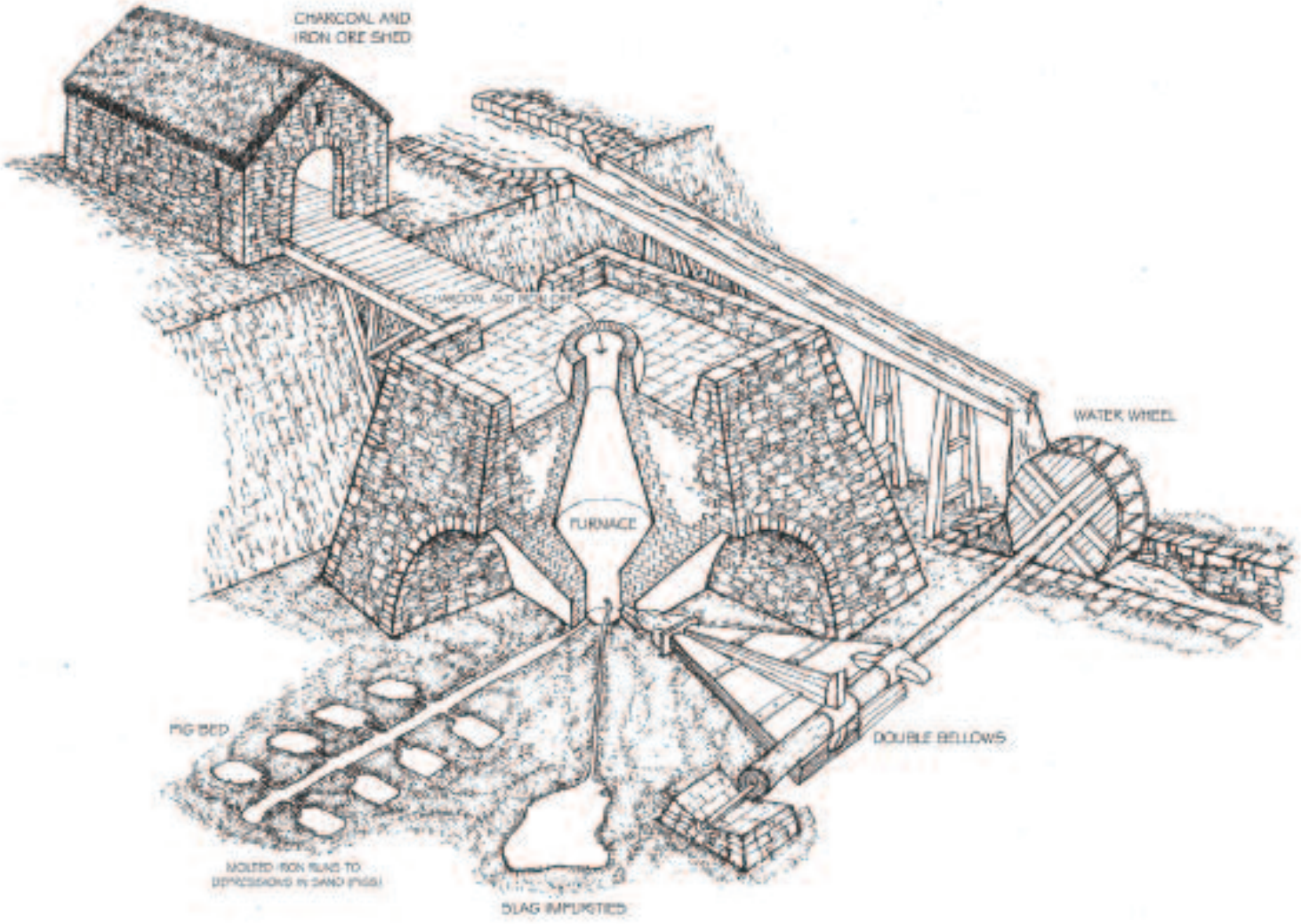
IRON SMELTING IN THE 17th AND 18th CENTURIES

Fragmentary records of historical Irish ironworks reveal a thriving industry in the 17th and 18th centuries. Iron making was transformed in the 15th century by the invention of the blast furnace. The blast furnace rapidly replaced the manually operated furnace, which had been known to man for at least 4,000 years. The main feature of the blast furnace was the blasting of air from a powerful blowing machine, consisting of two sets of bellows arranged to blow alternately and driven by cams on the shaft of a waterwheel. This new furnace could blow air continuously, day and night, in huge volumes.

Although charcoal, the same fuel, was used, it was now possible to attain much higher temperatures. For the first time iron could be melted and run off the furnace as molten cast iron. This molten iron was run into depressions in a bed of sand and allowed to harden. These depressions and the channel that fed them, shaped like a comb, resembled a sow with its litter, and gave the name pigs to the cast iron ingots produced in this way. Hence the expression 'pig iron'. Pig iron ingots could be re-melted and moulded by pouring into a box of sand, or two half boxes, moulded in the shape of the required object, where it would eventually solidify.

Cast iron contains up to 4.5% carbon, is crystalline in structure, and consequently very brittle. In order to be worked by the smith it has to be refined into wrought iron. The cast iron was reheated at very high temperatures, maintained by water-powered bellows, to melting point in a 'finery' furnace. Whilst in molten form it was continuously stirred by the forge workers to drive off unwanted carbon and impurities, leaving the iron to congeal in the hearth into what was known as a 'bloom'. The bloom was then further purified by reheating, and forged into bars under the blows of large water-powered forge hammers. Approximately 1.7 tonnes of charcoal were required to produce 1 tonne of wrought iron.

Furnaces were loaded from the top with charcoal fuel and the iron ore to be converted. They therefore tended to be constructed alongside hills with a short bridge linking the top of the furnace with the hillside.



Schematic drawing of a 17th century blast furnace.

Iron, usually in the form of iron oxides, is a commonly occurring natural element. Three types of iron ore were used in 17th century Ireland. Irish ore was found in both bedded masses and in veins. Bog iron ore was, as its name suggests, dug out of bogs. Some works, especially around Cork and Kerry, imported English ore, while some on the west coast used Spanish ore. The 1802 Statistical Survey of Mayo mentions vast quantities of iron ore in the Barony of Murrisk, in which Brackloon is located.

Colonel John Browne established iron works at Knappagh in 1687, which continued in operation well into the 18th century. The ironworks employed 150 men. He was supplying cannon balls, iron and tools to the garrisons of Athlone and Galway; at the same time he had orders to requisition men and provisions for the army and for the garrisons at Galway and Inishbofin. One reference mentions that the tools, arms and cannon balls supplied by Colonel Browne to the garrison at Sligo consisted of 220 shovels, 56 spades, 85 pickaxes and 965 cannon balls of three to five pounds in weight. A memorandum accompanying this list, dated April 1690, lists other items and the prices charged, including hand grenades, muskets with firelocks, firelocks without barrels, broad speararms and unground sword blades. The foundry at Knappagh, being on John Browne's estate, must have been the focal point for the manufacture of the tools referred to above, and the immediate surroundings have heavy concentrations of iron slag, along with stone and other materials which appear to have been vitrified. In common with iron works all over the country, those at Knappagh would have been fuelled by charcoal produced from local timber.

WESTPORT HOUSE AND THE BROWNES

Four hundred years ago John Browne, a son of Sir Anthony Browne of Cowdray Castle in Sussex, arrived in Mayo. For over the last three hundred years Westport House has been the home of his descendants; Colonel John Browne, his great-grandson, was born in 1638. He acquired vast estates in Mayo and Galway, and in 1679–83 built the first Westport House on the site of a ruined O'Malley Castle, which was destroyed by Cromwell. John Browne was a staunch Jacobite and took a prominent part in supporting the cause of James II in Ireland. He was appointed Lord Lieutenant in Mayo in 1689. He maintained ironworks at Knappagh, Westport and Foxford. The present Eleventh Marquess of Sligo is a direct descendant.

WESTPORT ESTATE PAPERS

The Westport Estate Papers, numbering in excess of 20,000 documents, were acquired by the National Library in 2001 from Jeremy Ulick Browne, the 11th Marquess of Sligo. Among the collection of his family's papers are documents and manuscripts spanning 400 years, from the earliest, dated 1541, from the time of Grace O'Malley, or Granuaile, the Pirate Queen, to the turn of the 20th century. The papers record the role of the Brownes in Irish society. The papers are currently being catalogued by the library and are due to be available for consultation by the public in 2005.

Brackloon appears to have been extensively used for the production of charcoal. Abundant charcoal occurs in the soils of the wood, either dispersed through the soil or as distinct layers at various depths in the soil profile. Relict charcoal hearths are also in evidence. Charcoal pieces recovered from one of these hearths have been radiocarbon dated to 300 years BP and 500 years BP, indicating that there was probably intense activity in the wood.

Among the Westport Estate Papers is an Article of Agreement made between John of Kinturk, Co Mayo, and John and Darby Murphy of Ballendaff, Co Wicklow, colliers, for annual delivery of 500 tons of charcoal at Westport or Knappa, dated 1683/84. The document states that the Murphys agree to deliver '*yearly and every year for five years next after the date here to deliver unto said John Browne at Westport and Knappa or either of them, 500 loads of good and well made charcoal fit for the furnace there and shall expend no more wood for the doing thereof than the best collier the said John Browne…doth or shall employ*'. In return John Browne is to pay them '*as good a rate as he gives to any other collier coaling at the like distance wood or ground*'. If John Browne desires '*he can get the wood cut and coarded and the coal carried and to deduct out of the price what will be paid for cutting and coarding and carrying the said wood*'.

In a book of accounts relating to the '*ironworks and other matters 1687–94*', there is mention of cutting of wood at Brackloon. In the book are tables of coal delivered. The first table relates to old stock and gives the name of the wood, the person and load and barrels. The second table refers to new stock.

There are 25 entries in this table relating to a number of different woods. Apart from Brackloon, other woods in the area which are listed include Feagh, Killmore, Derrylea, Bofara, Knappaghbeg, Killintiff, Claddee, Aylenagaple and Carrowkennedy.

'Old stock sent in by Hugh Hanley when he was undertaker of ye Bloomery in Knappa the year 1692'.

Date	Whente	The person	Load	Bar
4 Mar	Brackloon Upp	Roger Gauan	6	16
		more to Westport	1	2
1693				
	Brackloon Lower	John Noone	2	4
3 June	Brackloon Upp	Taige Kelly	4	12
10 June	Brackloon Lower	Roger Gauan	2	8
	Brackloon Lower	Roger Gauan	2	8

Coal new stock delivered since 'Mithas'[1] 1693 weekly at Knappa.

Date	The Wood	Undertaker	Collier	Carrier	Load	Bar	
1693							
Nov 4	Brackloon	Jo[ ] Cunnut	Pat O Hugh	-	3	12	old
			Wm Edy				
					2	19	
Nov 18	Brackloon	Roger Gauan	Pat O Hugh		2	19	old

[1]The feast day of St Mattheus occurred on 21 September and must be what is referred to as 'Mithas' in the table.

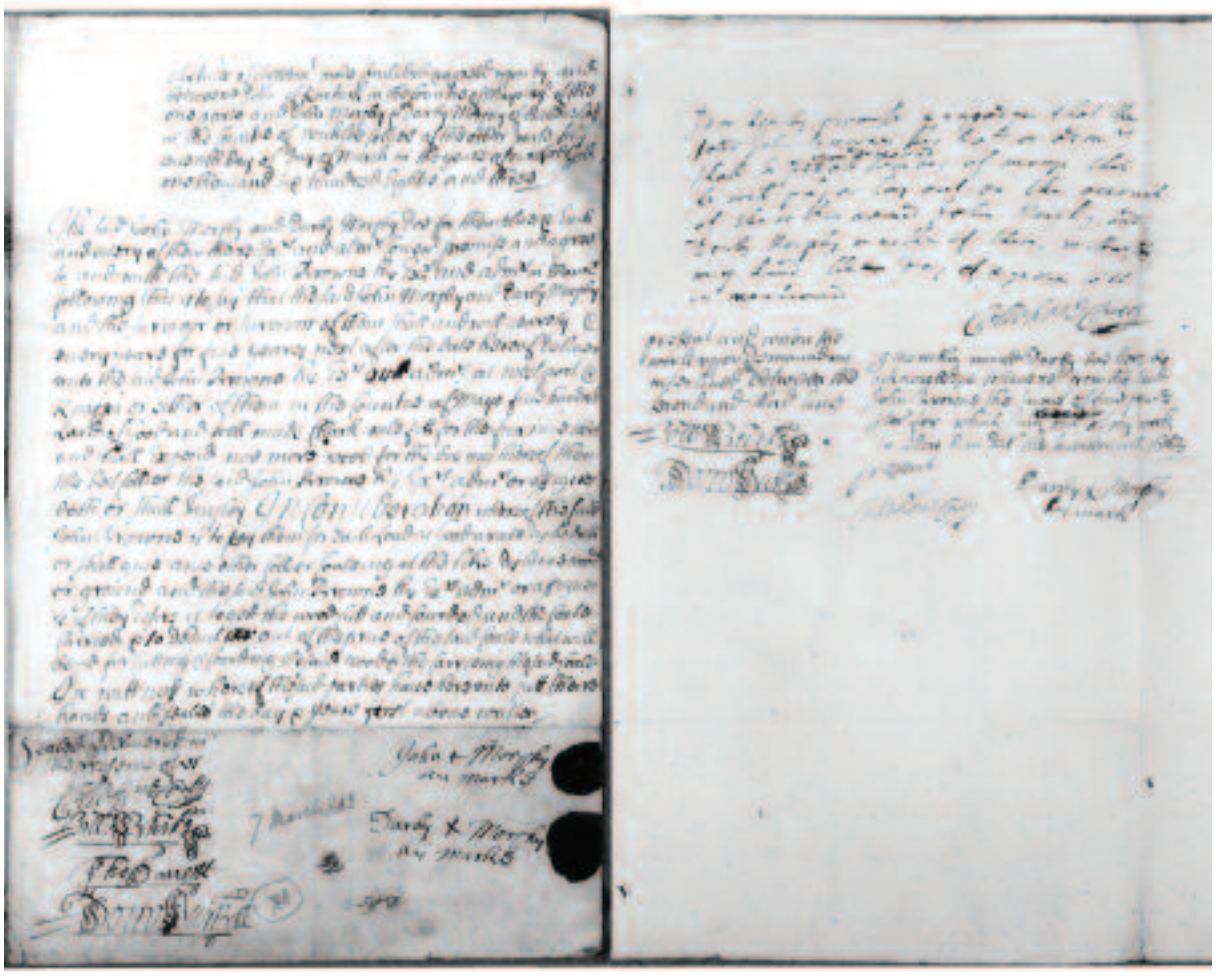
SOURCE: National Library of Ireland - Westport Estate Papers MS 40,915/3.

The tranquil appearance of many of these woods today belies their industrial past. Visitors in the 17th century would have seen plumes of smoke emanating from the charcoal hearths, and the blackened faces of those who had to remove and deliver the charcoal to the customer!

Population pressure increased in the region in the period leading up to the Great Famine of 1845–47, as evidenced by the ubiquitous lazy bed (relict cultivation ridges) features in the landscape. Population increases from 1700 to 1840 would have meant further reductions in tree cover with every corner of land farmed.

Young, in his *Tour of Ireland, 1776–79*, wrote about Westport and the Estate:

> *...It is very remarkable, that all the wild mountains in this country have marks, and to a great height of former culture, mounds of fences, and the ridges of the plough. Lord Altamont's great grandfather found the estate a continued forest; in 1650, those woods were of much more than a century growth, so that no cultivation could have been here probably of 300 years. There is a tradition in the country that it was depopulated by the plague, and upon that the wood sprung up which formed those forests. At present there is no woods on any of the hills, except immediately about Westport...*



Copy of Articles of Agreement made between John Browne of Kinturk, Co Mayo, and John and Darby Murphy of Ballendaff, Co Wicklow, colliers, for annual delivery of 500 loads of charcoal at Westport or Knappa for five years, dated 7 March 1683/4.

SOURCE: National Library of Ireland - Westport Estate Papers MS 40,897/1(3).

The Bogs Commissioners' report of the area (1813/14) states:

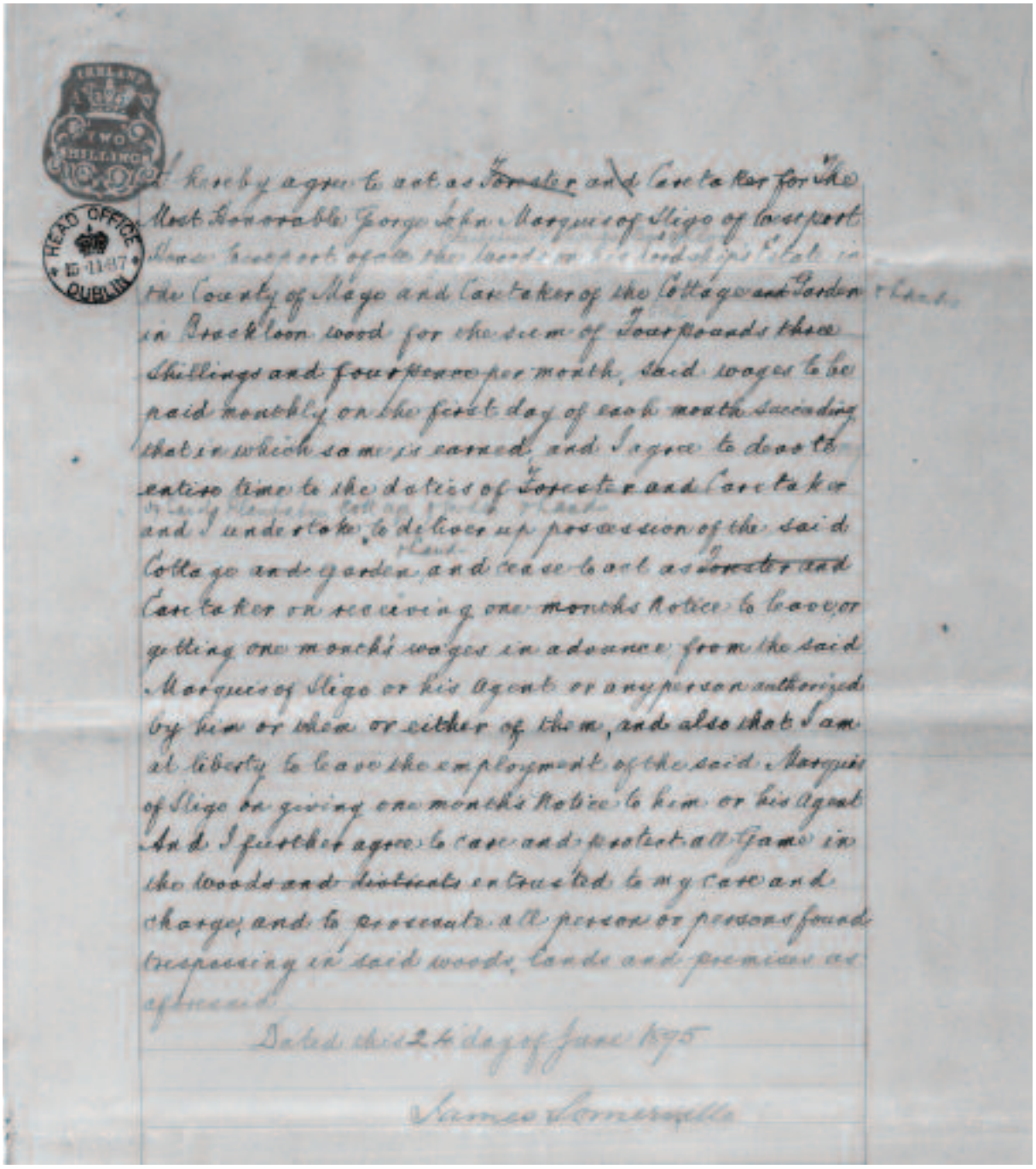
> *...Forty years ago the mountains in the neighbourhood of Westport were in a state very similar to that which the mountains of Tyrawley and Erris now exhibit. Many thousand acres of these once dreary wastes are now in a comparatively high state of cultivation, owing almost entirely to the prudent and liberal arrangements made by the late Marquis of Sligo, who gave the people long leases at low rents, finding them disposed to give their labour towards the reclamation of waste lands, provided that they and their children might be allowed to enjoy the fruits of their industry.*
>
> *The system of improvement usually adopted in the mountains of Westport, was, first to cut off the water from the mountain above, next to plough up and burn the surface, and afterwards to lime it. The whole of the lime that has been laid out on the face of these mountains, was carried in panniers on horses backs from the sea shore at Westport, which is the only place in the country where it can be procured.*
>
> *The Westport Mountains, like those of Erris, are chiefly composed of mica slate; and the effect which a small portion of lime has in fertilizing a soil arising from the decomposition of such rocks, is almost miraculous…*

Until the middle of the last century, lime was burned by most farmers and was applied to the land to improve the soil and used for whitewashing buildings. The abundance of limekilns is evident from the first Ordnance Survey of 1839.

Remains of barely perceptible cultivation ridges occur adjacent to a ruined cottage which was inhabited until the early decades of the 20th century. A member of the Lynch family, the last to reside in the cottage, is still alive and lives in Britain.

A wood ranger was employed for a time at Brackloon. A copy of the contract of employment between the ranger, James Sommerville, and the Marquis of Sligo dated 1895, survives among the Westport Estate Papers. In it, Sommerville agrees to act as forester and caretaker for the Marquis of Sligo of the woods on his estate and caretaker of the cottage and garden in Brackloon Wood for the sum of four pounds, three shillings and four pence (about €5.30) per month.

An old millrace runs through the eastern part of the wood. Water from the Owenwee River was diverted through the wood to work a number of mills in the area. The Ordnance Survey 6" map of 1839 shows three mills downstream from the wood. Mills for wool, bleach, flour and corn all operated at different times. Ruins of some are still standing today. They, along with the iron works, are testament to thriving historical industrial activity in the locality.



I hereby agree to act as Forester and Caretaker for the Most Honorable George John Marquess of Sligo of Westport House Westport of the lands in the Islands Estate in the County of Mayo and Caretaker of the Cottage and Garden in Brackloon wood for the sum of Four Pounds three shillings and fourpence per month, said wages to be paid monthly on the first day of each month succeeding that in which same is earned, and I agree to devote entire time to the duties of Forester and Caretaker and I undertake to deliver up possession of the said Cottage and garden and cease to act as Forester and Caretaker on receiving one months Notice to leave or getting one months wages in advance from the said Marquess of Sligo or his Agent or any person authorized by him or them or either of them, and also that I am at liberty to leave the employment of the said Marquis of Sligo by giving one months Notice to him or his Agent And I further agree to care and protect all Game in the woods and districts entrusted to my care and charge, and to prosecute all person or persons found trespassing in said woods, lands and premises as aforesaid

Dated this 24 day of June 1895

James Sommerville

Copy of employment agreement between fourth Marquis and James Sommerville, 1895.

SOURCE: National Library of Ireland - Westport Estate Papers MS 41,027/1.

RELICT CULTIVATION RIDGES

Relict cultivation ridges or 'lazy beds' are a feature often observed within old woodlands, usually in the vicinity of ruined dwellings. They are visible throughout the countryside. Many are located where woodland vegetation occurred before it was cleared to make way for agriculture in the latter part of the 18th century. After clearance, these sites were used for growing potatoes and oats, until their general abandonment (around 1850) after the famine, although they continued in use in some areas until relatively recently. During their preparation for growing crops, the top sod was lifted and inverted and manure incorporated in the soil as well as seaweed (in areas close by the sea), ashes (from soil burning) and possibly lime. Since abandonment, many of these sites have been used for rough or marginal pastureland but still exhibit a distinctive ridge and furrow or lazy-bed microtopography.

Descriptions of the Lots and Sublots for the townland of Brackloon were recorded in the Griffith Valuation of 1851. Descriptions were made to value the land for rateable purposes. The lots relating to Brackloon Wood include 7, 11, 12, 13 and 14.

Descriptions of most of the main lots are dominated by terms such as shrubby, rocky, heathy and boggy. The valuations of the main lots range from 3 to 7 shillings per acre, which places them at the lower end of countrywide valuations: < 1 shilling for deep bog to > 30 shillings for the best of tillage land in Leinster and Munster.

1901 CENSUS - TOWNLAND OF BRACKLOON

Year	Population	Houses
1841	128	18
1851	109	20
1861	49	10
1871	48	7
1881	59	8
1891	43	7
1901	34	7
1911	33	7

NO. OF LOT	DESCRIPTION OF LOTS	QUANTITY			AMOUNT OF LAND		
		A.	R.	P.	£	s.	d.
7	Shrubby and green boggy pasture injured by the overflowing of the mill race.	9	0	18	2	3	3
	Also water	1	1	20			
11	Rocky heathy moory pasture	14	1	32		10	10
	Also rocky bad arable	1	0	0		4	9
12	Moory and Gravelly Mixed arable	4	2	23	1	7	10
13	Rocky gravelly clayey arable on a rocky gravelly subsoil	6	2	11	3	13	11
	Also rocky pasture	6	2	0			4
	also waste at houses	6	3	0			
14	Gravelly moory rocky arable very uneven on a rocky gravelly subsoil	18	2	13	6	0	9
	Also boggy pasture	1	0	0			3
	Also rocky and green pasture	3	0	0		6	0
	Also waste at houses	3	0	20			

4 rood = 1 acre, 40 perches = 1 rood, 1 Acre = 0.3 ha,
£1 = €1.27, £1 = 20s, 1s = 12d

Route of millrace still visible but overgrown today.

Brackloon Wood as depicted on the first edition of the 6" map series of the Ordnance Survey (1839).

Ruins of wood ranger’s cottage.

OLD IRISH TREE LIST

In common with other European countries, the importance of trees and woodlands in the Irish landscape has long been recognised and attempts at woodland and tree conservation are not new. In ancient Ireland trees were classified into various categories with a series of laws governing their use, and fines for damaging or cutting trees without the landowner's permission. These laws are found in the 8 century law tract, *Bretha Comaithchesa*, or the Laws of Neighbourhood, and give the importance of various trees in the landscape.

The laws recognise a hierarchy of trees or bushes, arranged in four classes according to their economic value: the *airig fedo* or nobles of the wood, *aithig fedo* or commoners of the wood, *fodla fedo* or lower divisions of the wood and *losa fedo* or bushes of the wood.

Airig Fedo **nobles of the wood**	***Fodla Fedo*** **lower divisions of the wood**
oak	blackthorn
hazel	elder
holly	spindle
yew	whitebeam
ash	arbutus
pine	aspen
apple	juniper
Aithig Fedo **commoners of the wood**	***Iosa Fedo*** **bushes of the wood**
alder	bracken
willow	bog myrtle
hawthorn	gorse
rowan	bramble
birch	heather
elm	broom
cherry	gooseberry

The economic importance of the seven 'nobles of the wood' is summarised in an old Irish commentary on the law tract. The oak was included because of 'its acorn and its dignity', hazel for 'its nuts and its rods', holly for 'its grass for another and chariot shafts', yew for 'its noble artefacts', ash for 'its support of a royal thigh and half material of a weapon', pine for 'its resin in a bowl' and apple for 'its fruit and its bark'.

THE SOILS BENEATH THE TREES

Despite being underfoot and generally out of sight, soils have a long history of being the subject of notice and comment. Gerald of Wales (1185) used the words "*soft and watery, rather than rocky, with many woods and marshes, here and there some fine plains*". Four hundred years later Camden (1580) used the terms "*barren, rough, hungry…many woods and mires, so many rivers*" but within a hundred more years Boate (1652) had castigated the English adventurers who had "*made great havoc of the woods*". These, and many like them, make no specific reference to Mayo, but there is every likelihood that some lands at least retained a protective woodland cover for another century or two. In the 1770s Young found Lord Altamount reclaiming mountain land on his estate. The kinds of soils involved were not described other than "*heathy mountain land"*, "*wetness caused by lack clay*" (*leac liath*, indurated subsoil) and the benefits of draining. Commenting on the Westport area, Young wrote that the soil in general is "*a cold spewy, strong clay and loam*" and curiously, that "*the best lands in the country are the improved moors*". The manures listed were farmyard manure, sea wrack (weed) and composts.

We know that soils are continuously changing and responding to their environment— losing bases, gaining bases, accumulating plant litter, releasing iron and other minerals and so on, but these changes are often overshadowed by man's intervention such as lowering the watertable, burning the surface, adding liming agents and most particularly by digging and trenching.

In Brackloon, the archaeological evidence is that man has been using and altering the soils for many millennia, and what we see in its soils today is a 'snap-shot' or record of some of the changes, major and minor, inherited from the past.

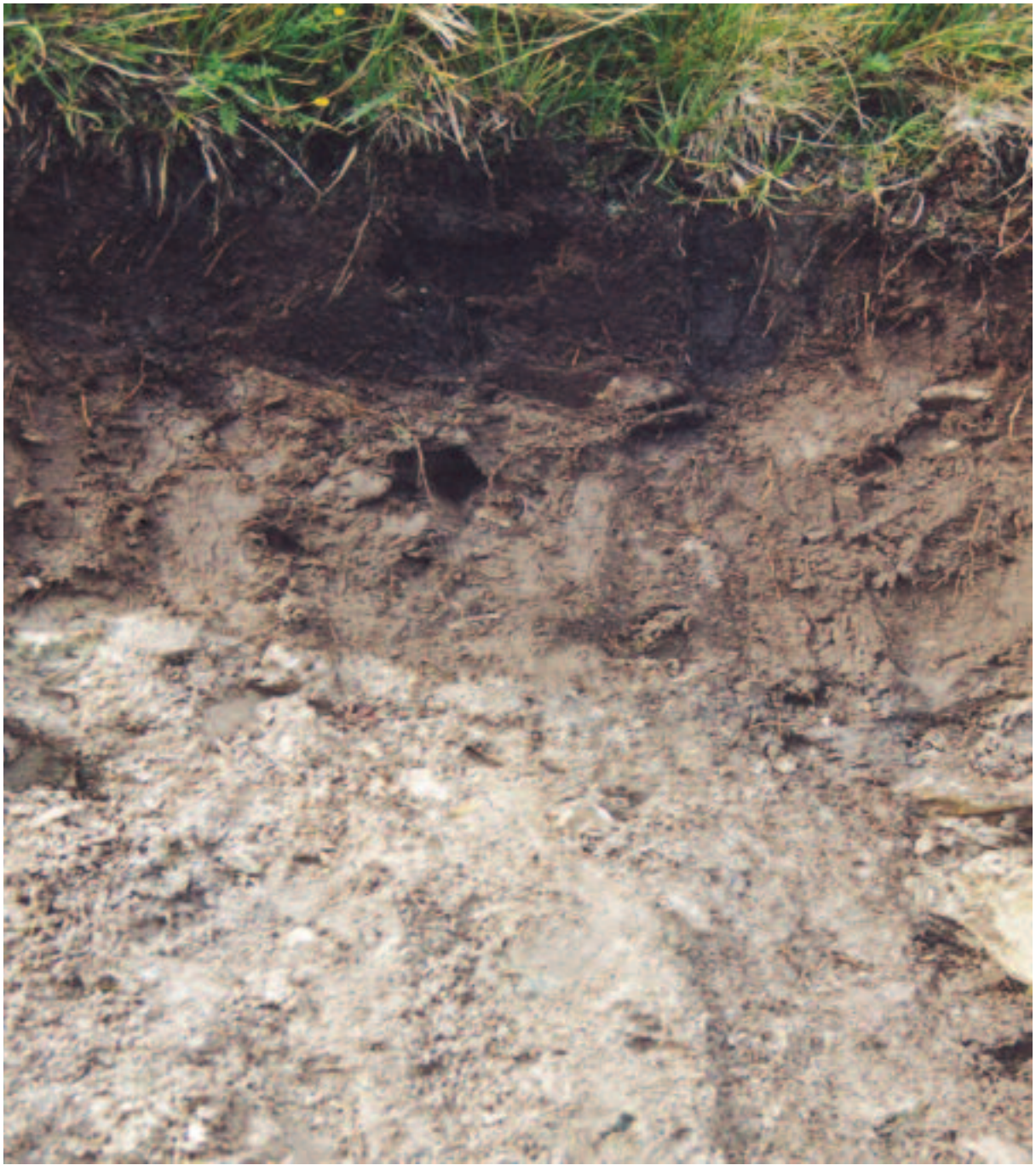
The soils of Brackloon are acidic, being derived mainly from silica-rich parent materials. The principal underlying rocks are schist and gneiss. A mosaic of different acid soil types occurs within the

PODZOL

Podzols are strongly leached mineral soils, displaying well-defined horizons of depletion and accumulation. They form mostly in high rainfall areas, on coarse-textured acid parent material, subject to ready leaching. They are characterised by a peaty surface organic O horizon. Beneath this is a leached ash-grey mineral E horizon, which in turn is underlain by a yellowish red B horizon, enriched in iron, aluminium and organic matter. The natural vegetation associated with podzols is coniferous forest and heath and moorland, which promote the development of an extremely acid surface peaty layer or ‘mor’ humus. However, they also occur under semi-natural oak wood in Ireland.

ACID BROWN EARTH

Brown earths are freely-draining loamy mineral soils. They have A, B and C (parent material) horizons but have little visible differentiation between the horizons, which are normally brown or reddish-brown in colour throughout the profile. The uniformly-coloured profile is due to the fact that there is little or no leaching. The middle or B horizon is weathered, but is only slightly leached at most and has not collected materials moved in from elsewhere in the profile. There are two types of brown earth – alkaline brown earths, referred to simply as brown earths, and acid brown earths. Acid brown earths are derived from more acidic parent materials and can be found at higher elevations than the brown earths.



PEATY GLEY

Peaty gleys are wet mineral soils with up to 45 cm of peat at the surface (more than 45 cm and they are classified as peats). A feature of poorly draining gley soils is that, under periodic or permanent waterlogging, the subsoil experiences a lack of oxygen within the pore space. Under these anaerobic conditions the insoluble iron oxides (which give the characteristic yellow, brown or reddish-brown colour to aerated soils) are reduced chemically and the ferric iron changed to ferrous iron prior to translocation from the soil profile. Minerals with iron in the ferrous form impart a grey or bluish-grey colour to the subsoil. The gleying process is not necessarily permanent and where it is intermittent, intense mottling with grey colours is characteristic. Where surface wetness is a feature throughout the year, the horizons are generally rich in organic matter, often intergrading into peats.

wood, ranging from relatively fertile acid brown earth soils to podzols to peaty gleys, each with their own distinctive properties and features.

The distribution of these soil types within the wood is largely determined by the topography. While variations in soil type are usually not obvious at the ground surface, a change in topography or in the natural vegetation may indicate a change in underlying soil type.

Acid brown earths tend to occur on the hilltops (about 100 m above sea level). Podzols are confined to relatively dry areas. Brown podzolic soils, intermediate between podzols and brown earths, occur on shoulder slopes and near foot slope positions. Gley soils have developed in poorly drained areas and hollows. Near the river the water table is high as a result of streams originating on higher ground, leading to seasonal overbank flooding, waterlogging and the development of peaty gleys.

Podzol exhibiting two phases of soil development.

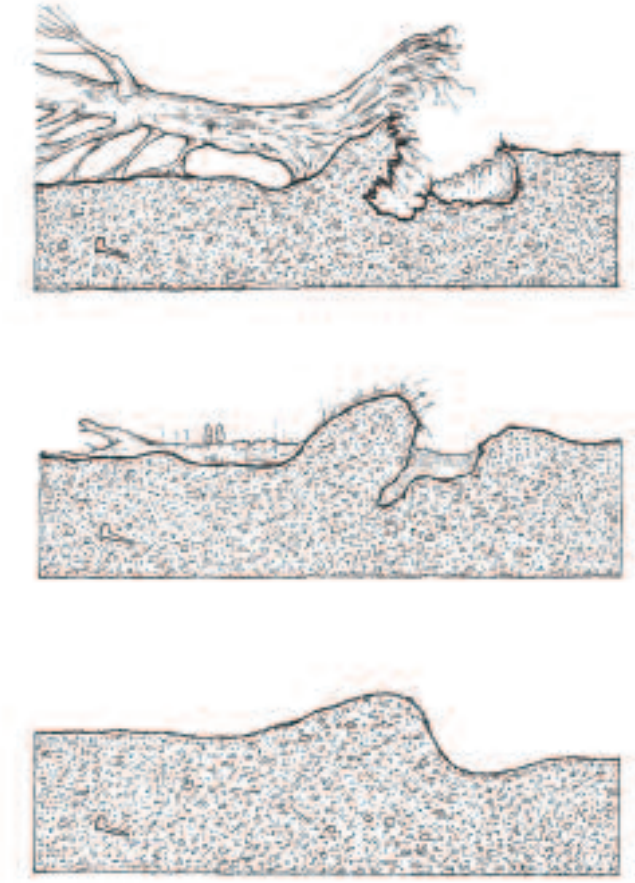
Past human disturbance is recorded in the soil profiles. Gleyed podzols are the dominant soils in and around the vicinity of the charcoal hearths at Brackloon. These soils have been denuded of their vegetation cover and with the export of charcoal there has been a net depletion/loss of bases. These soils occur in an area generally dominated by more base-rich brown podzolic soils. The more degraded nature of these soils, compared to the surrounding areas, is a legacy of historic charcoal production.

Some soil profiles in Brackloon exhibit distinct seams or layers of charcoal buried at depth in individual profiles. A continuous seam of charcoal occurs at a depth of about 40 cm in a profile near the ringfort. Close to the river, a seam occurs in another profile at a depth of 25 cm. The occasional burial of charcoal deposits at depth in these soils is a relict of natural perturbations (e.g. uprooting of trees) that existed side-by-side with man's activities such as cutting and coppicing.

As a result of windthrow a distinctive soil profile, exhibiting two phases of soil development, occurs at Brackloon. Soil material deposited on top of the original podzolic profile has resulted in a second upper sequence of horizons. This material, similar in composition to the buried material below — an amalgam of E, B, and C horizon material — was deposited on top of the original profile and homogenised. Following colonisation by vegetation, the accumulation of acidic organic matter on the surface and the decomposition of the organic matter, this material slowly became differentiated into horizons. The upper sequence exhibits weaker podzolisation than the underlying profile. During the first phase of soil development most of the primary iron may already have been released and leached. A 4–5 cm thick charcoal seam, at a depth of 25 cm — the original soil surface, occupies the boundary position between the two horizon sequences and separates the two phases of soil development. This charcoal has been dated to 1,370–1,260 years BP. The upper zone of the humic podzol is therefore pedologically very young, younger than the subjacent charcoal. This profile enables one to quantify the rate of soil formation under western Irish conditions.

Successive episodes of forest clearance in Ireland, dating from the time of the arrival of the first farmers over 5,000 years ago, to the relatively recent perturbations of the last few centuries, associated with timber export and fuel production, have all had degrading effects on the soil resource. However, it is likely that the first Neolithic farmers did not cause a net loss in soil fertility; their agricultural activities would only have scratched the surface of the soil, and when they moved to new grounds, secondary woodland would have reoccupied the site and gradually restored soil fertility. Late Bronze Age agriculture led to widespread clearance of forests in Ireland. However, this clearance was probably confined to the more fertile lowland areas, leaving the more remote mountainous regions intact. The earliest evidence of human disturbance in the more remote woods dates from the early Iron Age.

The more recent clearances that took place during the last few centuries have caused increased leaching and acidification of the soils and more intense podzolisation. This is illustrated at Uragh Wood, a native oak wood in south west Kerry, where changes in soil type were observed along a



Evolution of a pit-and-mound sequence.

PIT-AND-MOUND TOPOGRAPHY

A feature of natural woodlands is the rough pit-and-mound topography, caused by the natural uprooting of trees, or windthrow. This results in subsurface soil horizons being deposited on top of the forest floor humus layers. Erosion and natural soil turnover gradually diminish both mounds and pits, but even centuries after the windthrown trees have decayed, their presence is still marked by shallow pit-and-mound sequences.

transect through the wood. A gradual transition occurs from more base-rich soils, in an inaccessible undisturbed section of the wood, to more acid soils in the most disturbed section of the wood. In certain conditions, tree clearances have resulted in the formation of iron pan features and/or peat accumulation. Within 350 years of the complete removal of tree cover from part of the Uragh site, a peat layer, 8 cm deep, has accumulated on the mineral soil surface of an area of unenclosed marginal grazing land.

VEGETATION OF BRACKLOON

Deciduous woodlands, especially oak woods, are among our most ecologically rich, interesting and diverse habitats. They support an enormous variety of plant and animal life. Indeed, our oak trees have more animal species associated with them than any other species in Ireland.

Structurally, woodland vegetation is arranged in more or less clearly defined horizontal layers. One can commonly distinguish a canopy of trees, beneath which is an understorey of small trees or shrubs. Below the understorey is the field or herb layer, usually dominated by herbaceous plants. The ground layer is dominated by mosses.

Trees dominating the canopy at Brackloon include oak, birch, ash and rowan. Other trees occurring include elm and hawthorn. Holly and hazel form the understorey. Growing alongside these native species are introduced tree species, mainly beech and horse chestnut.

Brackloon is not a uniform forest in terms of vegetation cover. Although classified as semi-natural Atlantic oak woodland, at least 50 of the 74 ha of the wood were drastically altered through the establishment of coniferous crops during the 1960s. The tree species planted were non-native species such as Douglas fir, lodgepole pine, Sitka spruce and Norway spruce.

For management purposes the wood had been divided into 37 sub-compartments, each with a different management history. Some of these or small areas within them were unaffected by the planting of conifers. These scattered stands, either with a sessile oak canopy or a mixed deciduous canopy of ash and willow, over wet woodland ground flora, cover less than 20 ha of the wood and provide the only living remnants at this site of the once prevalent natural woodland climax vegetation of the region.

Although coniferous plantations fragmented the wood, the native woodland element and basic oak woodland structure persisted in places, as has been previously outlined. As knowledge about Brackloon accumulated and its ecological importance began to be recognised, the decision to restore the wood to close to its former state was taken.

A management plan was drawn up to facilitate the restoration of the semi-natural status of the wood and maximise its natural biodiversity. Funding was secured in the late 1990s from the Forest Service under their Woodland Improvement Scheme (WIS) to implement the plan. Although overall management responsibility for the wood lies with Coillte, the WIS project was carried out in conjunction with Sylviron Ltd, a native woodland management company.

Around this time too, the importance of our native woodlands and the need for their conservation was recognised by the government with the introduction of the Native Woodland Scheme. This scheme, launched by the Forest Service in 2001, aims to protect and enhance Ireland's native woodlands. Brackloon acted as a pilot project for this scheme. It has proved to be a very valuable pilot site in that many of the management operations carried out are typical of those used in other native woodlands in this scheme.

The first step in the restoration of the wood was the removal of the planted conifers. Most of these have now been cleared. Consequently, many clearfell areas, large and small, occur in the wood. Along with the conifers, non-native broadleaved species, sycamore and younger beech trees, were also removed. However, older 'veteran' beech trees were left untouched for their recreational and biodiversity value. A major element in the management of the wood and in the management of most of our remaining native oak woods is the removal of the invasive shrub rhododendron. A cutting and control programme was initiated, and approximately 20 ha have been cleared thus far.

Once the conifers had been removed, the next stage in the restoration of the native wood was to either encourage the natural regeneration of native woodland or to plant native tree species. Both approaches have been adopted in different parts of the wood. Where natural regeneration occurred, seedlings were identified and marked and protected. Where it did not occur, planting has taken place. Only material of native provenance was planted, grown from seed collected either in the wood itself or from the neighbouring Eriff oak wood.

Oak seedlings have also been planted in areas between the main oak woodland, an intact area of about 11 ha, and outlying blocks of oak woodland. Reconnecting all areas of existing oak woodland will defragment the habitat. This is essential to the maintenance of biodiversity, as it will allow oak-dependent species to colonise newly-planted and regenerated areas. Overstorey native species such as ash and Scots pine, in mixture with the secondary species related to that woodland type (e.g. hazel, rowan, holly, etc.), have also been planted. The aim is to create and recreate specific woodland types, suited to the site/soil type, particularly those that are impoverished and poorly represented.

Narrow-leaved helleborine.

Oak seedlings planted in clearfell area.

The second distinct approach to woodland establishment adopted was to encourage the natural successionary phase. Suitable areas for regeneration were identified and non-native species removed, and in conjunction with a maintenance programme (including rhododendron control), these areas were left to be colonised naturally and to develop to climax forest.

Natural regeneration within the wood has been phenomenal, especially of birch and willow. Birch is known to be a soil improver, paving the way for the eventual arrival of other species. Respacing of some areas of natural birch regeneration has already been carried out.

To protect the wood and promote and facilitate the growth of seedlings and newly- planted trees, stock had to be removed from the wood and stock-proof fencing erected.

The density of the forest canopy affects the composition of the ground flora growing beneath it. At Brackloon, the canopy is quite open, permitting the penetration of light to the woodland floor and the growth of a rich ground flora.

The most common ground vegetation species in the wood are great wood-rush, bilberry, honeysuckle, cow wheat, sweet vernal grass and common dog-violet. Hard fern is also found almost

Aerial photograph, Brackloon Wood and its surroundings.

everywhere on the forest floor. Wetter areas contain yellow iris, watermint, water horsetail, meadowsweet and soft rush. The rare narrow-leaved helleborine, an orchid of damp woods also occurs.

In April, before the leaves reappear on the trees, vernal species such as wood sorrel and primrose take advantage of the light and come into flower. As the emerging leaves in the canopy cast their shadow on the woodland floor more shade-tolerant species, such as bluebells, blossom. Throughout the spring, seedlings push up through the leaf litter in search of patches of sunlight. Only in the gaps not overshadowed by the mature trees will they have a chance of growing. All over the woodland floor, thousands of seeds lie dormant, waiting for one of the large trees to fall and allow much-needed light to reach them.

In Brackloon, the pattern of vegetation distribution is to a large extent dictated by soil type, which in turn is influenced by topography. Hazel, ash and a few elms grow on the most fertile soils. Birch, rowan and holly occupy the poorest soils, with willow growing in the wetter areas nearest the river and

Areas from which conifers have been cleared are rapidly colonised by foxglove and rosebay willowherb.

Bluebells begin to carpet the woodland floor in spring.

around the margins of Brackloon Lough. Sessile oak is found on all soil types.

Great wood-rush is a conspicuous component of the ground vegetation on the most acid soils. Wood sorrel and cow wheat are common here also. On acid brown earth soils, less acidophilous species such as herb robert and enchanter's nightshade are dominant. Hazel occurs in areas where the soil is less acid. Meadowsweet, soft rush, narrow-leaved helleborine and remote sedge are also common in the wet areas.

The legacy of past human disturbance is ubiquitous throughout the wood, and evident today in the vegetation. Anthropogenic influence on both woody and herbaceous vegetation is reflected in the open canopy, gaps in the vegetation and even-aged tree structure.

The recent removal of conifers has created many clearfell areas in the wood. Gaps in the woodland both as a consequence of clearfelling and charcoal production have created suitable areas for certain species to thrive. Clearfell areas are the sole habitats for sheep's sorrel, foxglove, rosebay willowherb and Yorkshire fog. Wood sorrel occurs in abundance on clearfell areas and generally on areas open to the sun. Permanent gaps where recurrent human intervention has occurred are covered with bracken, a vigorous fern, which turns golden brown in the autumn. It can grow to 2 m high.

Seven hundred and seventy five different species of plants and fungi occur in Brackloon Wood. Closer examination may increase this number. Most of the species are lichens, mosses and fungi — groups unsurprisingly abundant in an oak wood kept moist by its proximity to the Atlantic Ocean.

The different species of moss and moss-like liverworts forming a carpet on the woodland floor include tamarisk feather moss, lawn moss and oak-trunk moss. These are not confined to the ground but also form a blanket on the tree trunks and branches. Here they are known as epiphytes, obtaining their nutrients and moisture, not from the soil, but directly from the atmosphere. In western Ireland, the trunks of oaks are usually covered by the robust common oak-trunk moss.

Other small plants such as lichens and some ferns accompany the bryophytes. The humid climate and high degree of cloud cover in western Ireland assist the growth of these shade-tolerant ferns and bryophytes. As in so many oceanic woods, the boughs of Brackloon's oaks are clothed with masses of polypody ferns.

Many large mature windthrown oaks, a natural feature of ancient and semi-natural woodland, are to be found in the wood. These trees, supporting extensive epiphyte communities, provide important dead wood habitats.

Compared with the Killarney oak woods, Brackloon is not exceptionally species-rich in lichens. This is mainly due to its less extreme oceanic climate and its more turbulent regional woodland history. However, some sensitive mosses and liverworts that can only survive under a continuous tree cover

EPIPHYTES

Epiphytes are plants, such as mosses and lichens, which grow on other plants but are not parasites. Epiphytes are sensitive to changes in the environment and the epiphytic species most sensitive to environmental change occur in the canopy. At Brackloon a study of the lichen flora of a mature oak tree revealed 52 species of lichen.

occur. Botanist, Francis Rose's New Index of Ecological Continuity (NIEC) utilises 70 lichen species as an indicator to assess woodland importance on the basis of their lichen flora. Brackloon supports 30 of the lichen species on the NIEC, which implies that the wood is of conservation importance.

Sites that have been continuously wooded since 1600 are termed ancient. Despite recurrent human disturbance in the wood a number of ancient woodland species persist in the ground flora. These include cow wheat, wood melic, bluebell, early dog-violet, sweet vernal grass, giant fescue, and pignut. Their presence indicates that some areas remained continuously wooded throughout the Holocene and provided refugia for these species during periods of disturbances, from which they could recolonise when disturbance episodes had abated. Some of these species have even recolonised old pathways.

The tree and shrub flora of Brackloon was probably more diverse in the past than it is today. We know from pollen analysis that elm, hazel, oak and ash were far more prominent in the past vegetation than they are today. Species recorded in the fossil record that are absent from the wood today include Scots pine, yew, poplar (probably aspen), guelder-rose, elder, juniper and crowberry. Scots pine has, however, been recently reintroduced. These species declined and became locally extinct possibly due to change in climate, competition from other species, changes in soil fertility or human activity.

One of the major threats to the future viability of our native woodlands is the introduction of invasive non-native species, such as rhododendron. Ireland is very vulnerable to population explosion when new species are introduced, owing to its very small complement of flora and fauna. Even though it is assumed that humans have regularly augmented the flora since early Neolithic times (about 6,000 years BP), it was not until AD 1700 that the main exotic species were introduced into Ireland. Some species pose more of a threat than others. Rhododendron, and to a lesser extent laurel, have infested many of our native woodlands, creating a dense undergrowth and suppressing natural regeneration and growth of natural ground flora.

Apart from the 19th century introduction of rhododendron, beech and sycamore have become the best-established exotic species since their introduction. They can invade and replace sessile oak in woodland under undisturbed conditions.

Beech was introduced to the Westport area 200 years ago. It is most dominant at the western boundary of the wood. It is spreading by seed from the areas where it was planted. Most of these trees are around one hundred years old. Individual beech trees were planted along the western boundary and in an area in the south west of the wood. It has mainly established itself on well-drained slopes and it is likely to out-compete oak in the future on brown earth soils in such areas. It is likely that it will continue to dominate and spread within the western section of the wood unless it is controlled.

Opposite page: Beard lichen and shield lichen on low tree branch.

SESSILE OAK, DAIR, *QUERCUS PETRAEA*

Two species of oak occur in Ireland, the sessile oak (*Quercus petraea*) and the pedunculate oak (*Quercus robur*). Sessile oak tends to inhabit rocky, more acidic, less fertile habitats than the pedunculate oak. Sessile oak is the dominant species in oak woodlands in western Ireland. It grows best on drier soils.

Sessile oak can be recognised by the manner in which the acorn cup is attached to the branch. Unlike the pedunculate oak, the stalk joining the acorn to the twig is virtually absent. Its longer leaf stalk and the more regular lobing also help to distinguish it from pedunculate oak.

ASH, FUINSEOG, *FRAXINUS EXCELSIOR*

Ash is another species native to Ireland. It fits naturally into the landscape, both as a woodland and a hedgerow species, where it is very common. Ash regenerates freely on bare ground and in hedgerows. It requires moist but free-draining, nutrient-rich and sheltered, frost-free sites on which to produce quality fast-grown timber. Ash is a strong light-demanding species and is very sensitive to competition from weeds for both nutrients and moisture.

Ash, along with oak, is the last of the broadleaved species to flush in the springtime. Its crown and foliage are light. The combination of these two factors allows a high level of light to reach the woodland floor, thus fostering a rich array of flora and fauna beneath it. Ash is noted for its strong and flexible timber. It is the only species suitable for the manufacture of hurleys.

BIRCH, BEITH, *BETULA PUBESCENS and B. PENDULA*

Birch is a pioneer species, being one of the first to colonise bare or unused ground. It was the first tree to arrive in Ireland at the end of the last glaciation. There are two species of birch in Ireland: downy (*Betula pubescens*) and silver (*Betula pendula*) birch. It is difficult to tell them apart. Birch is common in acid oak woodlands. It is a soil-enhancing species with an ability to efficiently recycle nutrients, continuously improving or restoring soil fertility. It is one of the first trees to break into leaf in spring.

ROWAN, CAORTHANN, *SORBUS AUCUPARIA*

Rowan, also known as mountain ash, is a common tree in hilly, rocky areas that grows equally well on acid or alkaline sites. It will not tolerate waterlogged conditions and grows best on light-textured brown earths and more fertile peats. Rowan is tolerant of exposure and is often found in inaccessible places such as cliff faces, steep river gorges and rocky outcrops. It has striking red berries that appear in early autumn.

HOLLY, CUILEANN, *ILEX AQUIFOLIUM*

Holly is a small evergreen tree or dense shrub that can grow to a height of 15 m. It is often a major component of the understorey in many native woodlands, thriving beneath the taller canopy trees. Holly is abundant on both acid and alkaline soils. It is a hardy tree that can grow on exposed uplands. The female tree produces red berries in autumn, which are widely used as Christmas decorations.

SCOTS PINE, PÉINE ALBANACH, *PINUS SYLVESTRIS*

Scots pine, juniper and yew are the only conifers native to Ireland. Scots pine was an early arrival in Ireland after the Ice Age and remained a component of the vegetation until about 3,000 years ago, when it died out as the climate changed. There is some debate over whether any native Scots pine remain in Ireland. Most Scots pine growing today are from seed or plants originally imported from elsewhere, mainly Scotland. Scots pine has blue-green needles and the bark on the upper part of trunk is a distinctive orange-red to bright reddish brown.

BEECH, FÁIBHILE, *FAGUS SYLVATICA*

Beech is a European species with a natural range extending from southern Norway to northern Spain and from the south of England to the Black Sea. Beech was one of the trees that never made the crossing to Ireland before the rising sea level cut off the island from the European mainland. The date of introduction of beech to Ireland is suspected to be the 17th century, at Shelton Abbey in Co Wicklow. It was certainly planted on many of the estates in the 18th and 19th centuries. Where it is planted it does well in the drier soils of eastern Ireland and regenerates naturally.

Beech grows well under a wide range of soil conditions but does best where topsoil has a neutral or slightly acid (pH 6.0–7.5). For optimal growth it requires moist, free-draining soils of moderate depth but will nevertheless grow on a range of soils. However, due to its superficial/shallow roots it avoids waterlogged soils. It has long been acknowledged that beech loves a wet head and dry feet!

It is intolerant of late spring frosts and although tolerant of exposure, prefers a sheltered site where it can grow straight and tall. Beech is one of the most shade-tolerant species and as a result is successful at establishing itself as an under-storey tree and growing on to become the climax woodland species.

Beech, which can grow to a height of 40 m, is one of the most successful species in temperate areas. Its wide ecological range is only limited by its water requirements. Its intense transpiration rate requires moist climates with abundant foggy days.

RHODODENDRON, RÓDAIDEANDRÓN, *RHODODENDRON PONTICUM*

Rhododendron is native to the broadleaved warm-temperate forests to the east of the Black Sea. It was introduced to Ireland in the early 19th century, after being brought to Britain. An evergreen shrub ranging in height from 2–8 m, it is a highly competitive species, which spreads rapidly after its introduction and suppresses native plants. Widely naturalised in western Ireland, it is very invasive of woodland on acid and peat soils that are not permanently waterlogged. As in its native habitats, rhododendron builds up a very dense shrub layer, which hinders the growth and regeneration of other species.

CYCLES OF LIFE

In addition to light, water and nutrients are the main requirements for plant and tree growth. Plants obtain most of the nutrients they require for their growth from the soil. Some nutrients are held in the soil in forms that are very soluble; others are released only slowly from soil minerals or as a result of the decomposition of dead organic matter in the soil. Because of the high rainfall in the west of Ireland (at Brackloon it is over 1,700 mm per annum), nutrients are washed out, or leached from the soil, making it more acid. Chemicals released from the weathering of the minerals in the parent material neutralise this acidity. However, because the parent material from which the soils at Brackloon have developed is mainly schist and gneiss, they have a limited ability to neutralise acidity.

Natural vegetation systems, particularly undisturbed forests, maintain soil fertility and conserve nutrients very efficiently by recycling them. A large part of the available forest nutrient supply is locked up in the leaves of the trees and in the accumulated organic matter of the soil. Each year in the autumn, the leaves of deciduous trees change colour and fall from the trees. Accompanying the highly visible change in foliage colour is the invisible retranslocation process, whereby nutrients held in the leaves are returned to the woody tissue of the tree and stored, available for re-use by the plant in the next growing season. Nutrients are also washed from living foliage into the soil. Those remaining in the leaves when they fall to the ground are released back into the soil by the activity of fungi and bacteria, from where the roots of the trees and other plants can reabsorb them.

Rainfall provides an important supplementary source of some nutrients. It contains many important nutrients which, when they reach the soil, can be taken up by roots. Nutrients also reach the soil through the interception of gas and dust particles or associated with fog or mist. Forests are particularly efficient at trapping both nutrients and harmful substances from the atmosphere. They provide a porous canopy

through which the air can pass, acting as an efficient filter that removes both pollutants and natural constituents, such as sea salts. In this way, they cleanse the air of pollutants, but increase their deposition on the forest soil. The nutrients they remove can be valuable for the vegetation, but pollutants usually add harmful acidity to the ecosystem. It has to be remembered, however, that the major polluting substances also contain nutrients, particularly sulphur and nitrogen, which, in some instances, would otherwise be in short supply.

MYCORRHIZAS

Most plant species have a symbiotic (or mutually beneficial) association of their roots with specialised fungi. These associations are known as mycorrhizas, meaning 'fungus roots'. Mycorrhizas are extremely important in forest soils. The fungus benefits by receiving carbon compounds from the plant, and the fungus supplies the plant with mineral nutrients, of which phosphate is generally the most important. Mycorrhizas are very important in nutrient uptake by plants especially in soils low in nutrients. Human influence on nutrient cycling in forests is almost always negative, inhibiting the cycling to a greater or lesser degree.

The movement of nutrients between the various components of the ecosystem — air, water, plants, microorganisms and soil — is termed biogeochemical cycling. The many separate processes involved in biogeochemical cycling, comprising nutrient inputs, outputs and transformations, result either in increasing or neutralising the acidity of the ecosystem. The efficient cycling of nutrients is essential to the sustainability of forest ecosystems.

The composition of the rainfall and the throughfall has been monitored at Brackloon for over a decade. About 15% of the average rainfall of 1,700 mm is intercepted by the forest canopy. Water that is not intercepted and falls through the forest canopy is called throughfall and it carries with it part of the deposition trapped by the forest canopy.

Main elements of the forest biogeochemical cycle.

The proportion of incoming rainfall intercepted by the natural deciduous oak canopy at Brackloon is less than in a dense coniferous plantation. It might be expected that interception of ionic substances would follow the same pattern but at Brackloon this does not appear to be the case. Although the canopy of the coniferous forest intercepts a much higher proportion of incoming rainfall, throughfall rates of ions are similar. The unusually high interceptive ability of the open canopy oak wood at

Brackloon may also be due to the high proportion of epiphytic vegetation in the stand and particularly the moss and lichen communities.

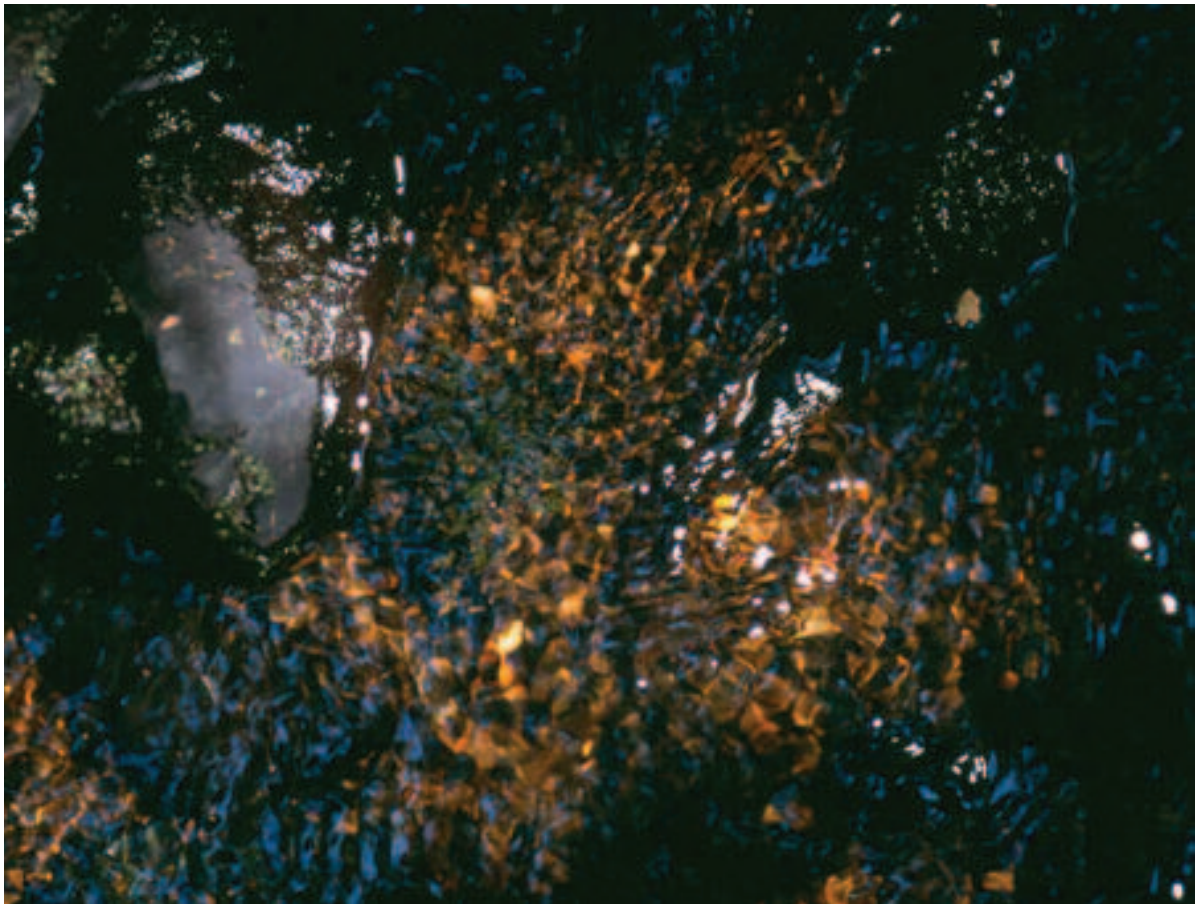
Although the rain at Brackloon is relatively clean compared to that on continental Europe or indeed on the east coast of Ireland, there is evidence of a small but significant pollution influence in the region. However, atmospheric inputs of the main pollutants which cause acidity are low. Nitrogen deposition is particularly low and there is evidence that it is being taken up by the canopy. This could imply that the forest is nitrogen limited. Nitrogen outputs from the soil below the rooting zone are virtually undetectable, despite low but important inputs in precipitation and from decaying leaf litter.

Atmospheric deposition in maritime regions is dominated by sea-salt. The marine influence is strong at Brackloon, with high inputs of the main marine ions: sodium chloride, magnesium and sulphate. Enormous fluctuation in sea-salt deposition occurs as a result of storms. The sodium throughfall load is highest in winter when the frequency of depressions, approaching from the Atlantic is greatest. By contrast, deposition is very low in summer. The impact of a major storm, which occurred in the region in early January 1991, is illustrated by the fact that throughfall deposition of sodium in that two week period represented 78% of its total deposition for the entire year!

With efficient recycling, net loss of nutrients from an ecosystem can be close to zero. In general, very few nutrients are lost from undisturbed forests. The extent of nutrient leaching from soils depends on both the amount of water moving through soils to streams and on the concentration of nutrient elements in the soil water. Undisturbed forests exert considerable control over both these factors. Transpiration demand by vegetation and interception of rainfall by the canopy reduces the amount of water moving to streams. Deciduous woodland, with a relatively open canopy structure, can, as shown, intercept as much as 15% of incoming rainfall. Use by vegetation and soil microbes reduces the nutrient content in soil water. The ability of microbial communities to grow rapidly provides an important nutrient-conservation mechanism in ecosystems. Even in intact forests, microbes may be important in retaining nutrients during periods when tree uptake is low, e.g. uptake by soil microbes can reduce nitrogen loss during early spring when nitrogen uptake by trees is still low.

Nutrients may be lost to streams either as dissolved substances (i.e. in solution) or as particulates (i.e. undissolved organic or mineral particles transported either in soil water or overland with eroding soil). Solution losses consist primarily of soluble anions and cations whereas particulates contain a high proportion of the less soluble minerals. The potential for nutrient leaching to streams is generally high in temperate deciduous forests.

Leaching is accelerated when the equilibrium of the forest has been disturbed, such as where atmospheric deposition is too high, or where the forest cover is removed. This results in significant losses of nutrients, which may deplete the ecosystem and/or cause eutrophication of adjoining surface waters.



Changes in forest ecosystems generally occur slowly in nature. Deposition and its impacts vary greatly with weather conditions and, as with climatological monitoring, evidence of adverse effects only become manifest after many years. Long-term monitoring is therefore required to provide the level of understanding of ecosystem function needed before reliable generalisations can be made about such complex systems.

ANIMALS OF BRACKLOON

Animal life abounds in Brackloon. Creatures living in or using the resources of the wood include mammals, birds and invertebrates. The activity of many of these animals is not immediately obvious to the casual visitor; most are small, some live under the cover of the dense ground layer, others appear only at night.

Mammals of Brackloon

Brackloon is used by seventeen different mammal species, or just over half of the total range found in Ireland. Among the most conspicuous using the resources of Brackloon Wood are the badger, pine marten and wood mouse. Fox and hare are also present. Other mammals to be found less frequently include the stoat, pygmy shrew, mink and hedgehog. An array of bat species are also present. In addition to sightings, signs of mammal activity in the wood occur in the form of burrows, hairs, droppings and diggings.

Woodlands are an important habitat for mammals. They provide their basic requirements of food and cover, and breeding sites. Some mammal species are woodland specialists, completely dependent on the woodland for their survival, while others are generalists, utilising the wood, but adapted to a variety of habitat types. Woodland specialists include the pine marten and red squirrel.

Although rare today, many of Ireland's indigenous mammals are adapted to living in mature broad-leaved woodland, due to its previous dominance over much of the landscape. Remnants of native woodland, such as Brackloon, are therefore of considerable importance in the conservation of several mammalian species.

WOODLAND MAMMAL SURVEYS

Larger mammal activity was studied by systematically surveying the wood between July and September. The boundaries and main forest roads were searched. Evidence of burrows, hairs, droppings, diggings and sightings were recorded and mapped. Reliable casual sightings were also recorded

Small mammals were surveyed by line trapping. A number of parallel traplines were established at regular distances apart. Trapping stations were positioned at intervals along the trapline. The traps were positioned under or alongside whatever, if any, cover was available. They were supplied with hay as bedding and baited with oats. Minced beef was also provided in each trap when trapping pygmy shrews. Each session comprised of 48 hours of pre-baiting followed by two nights of trapping. Trapping was carried out over an eight-day period at the end of the summer. The catch was examined the morning after trapping.

Brackloon, although essentially a woodland habitat, contains within it a variety of physical features that provide additional habitats for living organisms, including the river, hedgerows lining the road, stone walls, souterrain and the ruined dwelling.

Brackloon and its surroundings are also an important habitat for mammals in terms of the diversity of vegetation and the dynamic nature of woodland development. The intact mature oak stand, the clearfell areas, regenerating scrub and the nearby coniferous plantation offer a mosaic of habitat types for its mammals. Different vegetation species provide a variety of food types such as berries, nuts, seeds and leaves for mammals to feed on.

Badger activity, in the form of setts and paths, is conspicuous and widespread in Brackloon, and it would appear to be home to a sizeable population. Badger activity is mainly concentrated at the north end of the wood. One main sett, with 41 entrances, linked by well-defined paths, along with a number of subsidiary and outlier setts was located within the wood at the time of the survey. Associated with the setts were two latrine sites, only one of which was in regular use. Badgers have a preference for wooded areas rather than clearfells. Badger paths are distributed unevenly within the wood. They are mainly concentrated in the woodland area and do not extend into the clear fell. There are very few paths crossing the western boundary of the wood into adjoining pastureland. Another sett is located at the eastern bank of the river. Three large latrines, all in use, are located along the river. All setts found in Brackloon are constructed in or near a slope and are located in free-draining loamy soils. Badgers tend to construct their setts in easily worked soils. No more than one badger was seen at any time in Brackloon, but the extent of the main sett and the territory would suggest a sizeable population.

It is not surprising that badgers are utilising the wood as a habitat. In Ireland, it is generally found that hedgerows and woodland are preferentially selected for sett digging while grassland, moorland and bogs are generally avoided. In addition to the general landscape composition around Brackloon, positive attributes of the wood for the badger, include the locally common easily dug and well-drained brown earth soil, vegetation cover, lack of human interference, slopes and altitude.

Although there is a lot of pine marten activity in Brackloon, sightings of this elusive creature are rare. Frequent faecal evidence, or scats, however occurs throughout the wood. In Brackloon, most scats are found on man-made physical features and surfaces. Droppings are frequently found on forest roads, the bridge and stonewall boundaries. The scats are usually found in prominent places and pine martens are believed to mark their territories in this way. It is likely that such features channel the marten's activities whilst foraging from one part of the wood to another. Pine martens tend to hunt along walls and along the edges of woodland more than within the woodland itself. The pine marten apparently also likes to hunt in areas from which coniferous forest has been clearfelled, particularly in areas where herb and scrub species have begun to recolonise the ground.

Pine martens are solitary animals, which tend to occupy large home ranges, often more than 10 km^2. Despite the widespread evidence of pine martens in Brackloon, there may be just one pair present in the wood. A fall in pine marten activity occurred during a period of forestry management-related activity indicating that these species are sensitive to disturbance. They are quite inquisitive and one was a regular visitor to a dwelling near the wood in search of food and shelter.

Frequent sightings and signs of pine marten during the summer seem to indicate a lot of activity at this time. Male and female ranges overlap, but this does not occur with same sex individuals. Thus if there is more than one pine marten resident in Brackloon, they are most likely to be a pair. Rocks, together with stonewalls and old trees, dispersed throughout the wood, provide refuges for the pine marten and the stoat. The river, natural streams and drainage channels ensure water is never in short supply.

Widespread evidence of fox activity occurs in the wood. In addition to sightings, fox droppings are frequently found at numerous locations throughout the wood. It is not unexpected that foxes occur in this environment, being opportunists that are common throughout the country. In addition, woodland habitats provide ample food and cover. Its diet at Brackloon includes large quantities of beetles; fur and bones are not evident in its droppings.

Evidence of mink in Brackloon was confined to the banks of the Owenwee River. Mink distribution is strongly correlated with the density of mature trees on bank sides. These trees are often pollarded and hollow, and are useful den sites for mink.

The wood mouse and the brown rat are prevalent throughout the wood. Dense ground cover in all instances favours small mammals. These two, together with birds, frogs, and invertebrates, especially beetles, can occur in the diet of the fox, stoat, pine marten and occasionally the badger. Evidence from the Killarney oak woods shows that wood mice numbers dramatically increase during the autumn, related to the increased supply of acorns and other seeds in the wood at this time.

There is no evidence to suggest the presence of the red squirrel in Brackloon. Reintroduced to Ireland from England during the 19th century, having become extinct in Ireland at least twice, they appear to be in decline again at present. They are believed to be thinly distributed throughout the country but may be locally common. Very much at home in coniferous woodland, they are also found in mixed woodland and usually scarce or absent in deciduous woods. They require large mature trees in order to survive. However, some believe that in deciduous woods, young dense cover is preferred. The presence of squirrels in Brackloon Wood would be beneficial from many perspectives: increasing mammal diversity, overall conservation value of the wood and expanding the nationwide distribution of the squirrel. Successful introduction and population establishment would depend on whether the wood could sustain a red squirrel population. However, there are no known cases of translocating red

squirrel in Ireland. They are highly sensitive to disturbance and a high mortality rate would be expected during and after translocation.

Brackloon's Bats

Brackloon hosts an unusually large and species-rich population of bats. Six of Ireland's nine known bat species are to be found in the wood. Of these, Daubenton's bat is the most abundant, followed by the two species of pipistrelle, common and soprano. Leisler's bat is less abundant. The natterer's and long-eared bats are rarely observed. Some of these species are probably migrant rather than resident.

The abundance and diversity of bat life in Brackloon are due to the variety of habitats present in the wood, including the man-made physical features: the hedgerow along the road, the river, bridges,

BATS

Nine species of bat occur in Ireland, accounting for almost a third of all Irish mammal species. Bats are the only mammals capable of true flight. They forage at night and to navigate in the dark, bats use a technique called 'echolocation'. They produce a high pitched sound, beyond the range of human hearing. When this sound hits an object, an echo is produced, which travels back to the bat to guide its flight.

Bats feed on a wide range of insects and play an important role in controlling insect numbers. They hibernate to survive during the winter, when food is in short supply. During hibernation their body temperature drops from 37^{o}C to 10^{o}C or lower, and heart rate from several hundred beats per minute to between 5 and 20 beats per minute. The energy needed to sustain the bat during hibernation is accumulated during long feeding periods in the autumn and stored as body fat.

Hibernating bats are extremely vulnerable to disturbance. A bat with a body temperature of 10^{o}C takes at least 15 minutes to wake up and flee from danger, using up valuable energy reserves. If a bat is disturbed too often during hibernation, it can die. Bats breed just once a year, giving birth to a single offspring, usually in June or July.

souterrain, ruined dwelling and clearfells. Bats are most frequently encountered along the river, especially Daubenton's bat. This is a most important place because of the rich insect life associated with the aquatic environment. The bridges are used as a roost by a Daubenton's bat female colony. Pipestrelle and natterer's species can also be found in the vicinity of waterways.

The road surrounding the wood, with the semi-natural hedgerow running parallel to it, which supports abundant insect communities, is another good food source for bats. The fact that the road occurs at the edge of the wood further affects the abundance of bats found here. Both species of pipistrelle can be found foraging around these hedgerows. Of the small percentage of bats found in the wood itself, a number were Leisler's bats foraging above the wood, the rest were found foraging along woodland paths and small clearings.

Many studies on bat foraging have reported that semi-natural broadleaved woodland was a preferred habitat. There is no evidence of bats using the small stands of coniferous trees that remain in the wood; coniferous forest is generally considered a less optimal woodland type. The souterrain in the ringfort near the centre of the wood is a suitable roost site for some species.

BRACKLOON BAT SURVEY

Two transect routes were delineated in the survey area, one along the eastern boundary parallel to the river and one along the western boundary. Each transect route was walked on a number of different occasions during the summer, starting 30–45 minutes after sunset. All habitat features in the survey area were recorded. Other conditions recorded during the survey included the distance covered, time taken to walk the transect, weather conditions (wind speed, cloud cover and temperature) and relative insect activity. The number and position of bat passes or feeding signals heard or seen were recorded. Bats were observed using Eco Tranquility and Sky bat-detectors. All bat calls were also recorded using a digital audio tape recorder. Species were identified during the survey and confirmed later by analyses of sonographs of the recorded calls.

More bats are recorded along woodland edges than within woodland gaps, probably because this environment has higher insect densities and offers good flying conditions without obstacles. Only a small number of bats are found in the clearfell areas and this can be explained by insect abundance. There is no evidence of long-eared and Leisler's bats feeding in the wood. Weather conditions are an important factor in bat activity. The number of bats seen and heard is greatest in windless and rainless conditions.

The removal of the coniferous stands may have caused some short-term disturbance to the bat fauna of the area as some bats keep to fixed flight paths, but in the long term insect abundance will increase in these areas and should result in an increase in bat numbers.

Bats are known to be sensitive to changes in the environment. Their numbers have declined significantly in the last century due to a combination of loss of habitats, roost sites, food supply and an increased frequency of disturbance. Bats are therefore believed to be useful indicators of environmental change. Woodland sites are important for the conservation of bats.

Soil fertility, tree species and vegetation structure all influence the occurrence of mammal species and population diversity within woodland. The dynamic nature of woodland development at Brackloon suggests that mammal distribution will continue to change in the future. Species that are present today may become more abundant and other species may arrive, as the wood continues to evolve and as conditions become more favourable for them.

Invertebrates of Brackloon

Invertebrates currently account for up to 95% of the known diversity among terrestrial animals. Woodland habitats are home to the greatest diversity of small invertebrates. This is because they are very varied environments, with many hiding places and abundant food. This rich wildlife can be found in the trees, herbaceous plants and flowers, on dead and rotting wood and on the ground. About 10% of woodland invertebrates are associated with dead wood. It has been estimated that a single oak tree can support up to 200 different insect species. Up in the canopy is a whole different world to what happens on the forest floor. Some invertebrates are associated with fairly specific woodland sites and plants, while others can be found almost anywhere. Although mostly inconspicuous, the invertebrates are essential elements in the woodland ecosystem, helping to recycle the nutrients in fallen leaves and branches.

In temperate forest ecosystems much of the invertebrate diversity is found in the soil and leaf litter microhabitats. The litter and soil invertebrate fauna was studied at Brackloon. A total of seven classes, encompassing sixteen orders, of invertebrates are recorded at Brackloon. Most invertebrates found can

SOIL AND LITTER INVERTEBRATE SAMPLING

Sampling of litter invertebrate fauna was carried out using pitfall traps sunk into the ground. Plastic buckets were located so that the lip of each bucket was level with the ground surface. The traps were located at approximately 10 m intervals and each trap contained half a litre of 5% formaldehyde mixed with ethylene glycol. The traps were left for 4–6 week periods between sampling. Throughfall was diverted away from the traps, to prevent flooding, by a temporary roof constructed over each bucket. This did not limit access by invertebrates. After sampling, the invertebrates were transferred to 70% alcohol in the laboratory. Carabid or ground beetles were removed and identified to species level, while all other organisms were divided into groups. Four sites were selected to sample soil macrofauna, one in each of the soil types; typical brown earth, typical brown podzolic soil, podzol and gley soils. The first sampling was carried out in early summer when 12 quadrats were chosen in a 5 x 5 m plot in each of the 4 sampling sites. In autumn, a further 6 quadrats were chosen from within the same survey area, in order to assess juveniles in the population that were not present in the early summer.

be divided into three groups: predators, which hunt and consume live prey; detritivores, which live off dead animal and plant material; and fungivores, which eat fungal material. Typical woodland invertebrates found in Brackloon include predators such as mites (part of the Order Acari), spiders (Araneae), centipedes (Chilopoda) and harvestmen (Opiliones). Detritivores including millipedes (Diplopoda) and woodlice (Isopoda) were common as were the fungivorous springtails (Collembola). Millipedes are the most numerous group found at Brackloon.

A diverse range of beetles or Coleoptera were found, including rove beetles (Staphylinidae), burying beetles (Silphidae) and dung beetles (Scarabaeidae). Members of the Staphylinidae, such as the Devil's coach horse, are aggressive predators, the Silphidae have many examples of scavengers, and the Scarabaeidae are vegetarian or dung-feeders.

The range of soil types affects the density and diversity of invertebrate soil fauna found in different parts of the wood. Earthworms are particularly sensitive to soil acidification and are therefore restricted to certain soil types. The brown earth supported the largest earthworm populations, while other soil types are species-poor.

BADGER, BROC, *MELES MELES*

The Eurasian badger is one of Ireland's most common large mammals. Badgers are social animals, usually living in small groups. Each group consists of a dominant male and female, accompanied by a variable number of other adults and juveniles. Badgers live in complex underground tunnel systems called setts. Besides the main sett, each territory generally consists of an annexe sett nearby. Further away there can be a number of small subsidiary setts, which are less often occupied. Towards the edges of the territory there may be one or two isolated outlier setts. Within a few metres of the sett, there is often a latrine, consisting of a series of shallow pits. This system of boundary latrines is used as a defence against neighbouring groups. Conspicuous paths often interconnect these latrines with the main sett. Badgers regularly patrol these boundary paths, visiting latrines and renewing scent deposits.

Defended territories require soil suitable for digging setts, and an adequate food source. The badger is omnivorous and earthworms are the main constituent of its diet. Badgers are found in a wide range of habitats, with setts most often located in woodlands and copses, scrub and hedgerows. In Ireland, however, badgers have adapted well to the relative lack of woodlands and are found in all habitats below about 500 m altitude where the soil is dry and not subject to flooding. They may be found on mountains but tend to be more solitary in these habitats. Nocturnal animals, shy of man, most people rarely see badgers alive.

PINE MARTEN, CAT CRAINN, *MARTES MARTES*

The pine marten is one of Ireland's most elusive mammals. It belongs to the family Mustelidae, which includes the badger, mink, otter and stoat. Similar in appearance to mink, this attractive cat-like animal has a long slender body with long legs and a pointed head, and a creamy patch on its throat. Assumed to have colonised Ireland after the last Ice Age, its widespread distribution suffered serious decline in the 17th century with the deforestation of the country, which destroyed its habitat. Pine marten was quite rare until recently, but is now recovering and extending its range to most parts of the country. Martens have a strong preference for tree cover; its main habitat is deciduous woodland or scrub with good ground cover. Recently it has begun to colonise mixed woodland and coniferous thickets. Pine martens are omnivores, taking a wide variety of foods depending on what is available.

STOAT, EASÓG, *MUSTELA ERMINEA*

The Irish stoat is Ireland's smallest carnivore. It is unique to Ireland and is often incorrectly called a weasel. This native mustelid has a nation-wide distribution. It occurs in a wide range of habitats, from lowland agricultural country, marsh and woodland to mountains. The distribution of stoats is closely related to cover and food supply. Believed to be active day and night, it inhabits a variety of dens and holes for refuge, including tree holes, bird nests, stone walls, rocky crevices and prey burrows. Before myxomatosis was introduced, the rabbit was its staple food. Now birds are the main constituent of its diet, followed by hares and rabbits and small rodents. In the event of food scarcity, it will eat earthworms, rats and large insects. It may be predated upon by hawks, owls and larger carnivores.

FOX, SIONNACH/MADRA RUA, *VULPES VULPES*

Common and widespread throughout Ireland, this dog-like carnivore thrives in a variety of locations and has no particular habitat, living in wooded areas, remote moorland and busy suburbs alike. The fox has a variable diet with rodents, rabbits and hares often being the chief constituents. However, shrews, invertebrates, birds and large mammal carrion are also food sources for the fox.

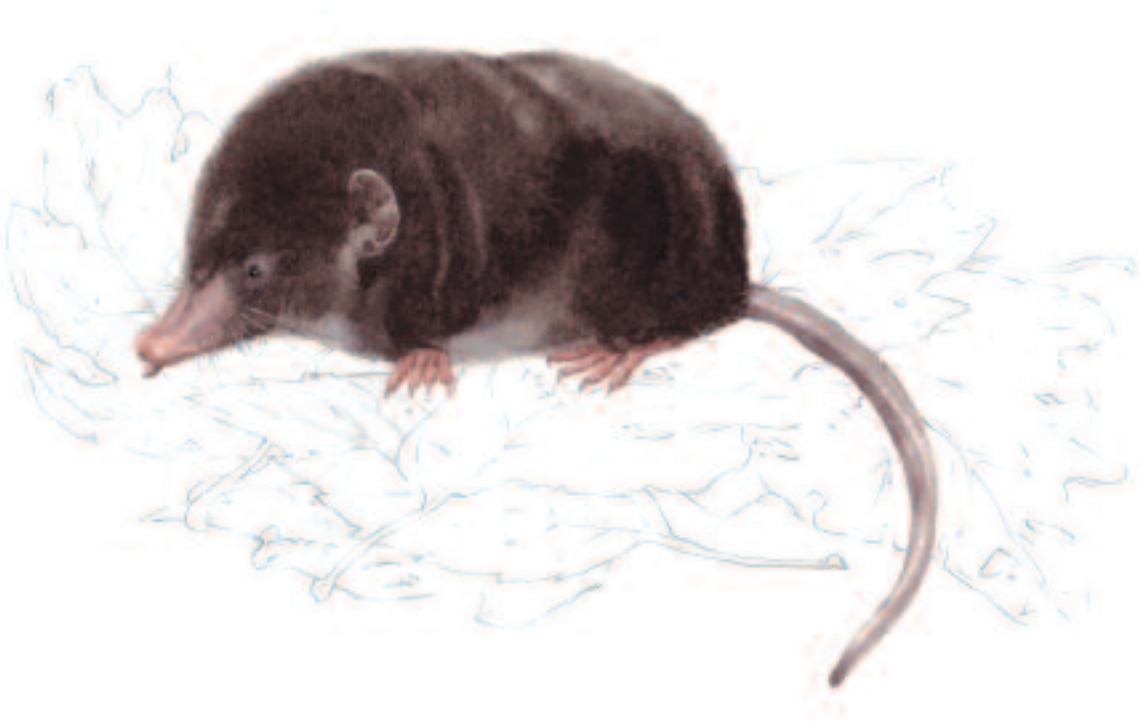
AMERICAN MINK, MINC MHERICEÁNACH, *MUSTELA VISON*

Native to North America, mink was introduced to several European countries for the commercial value of its fur. Feral mink have a preference for living by the waterside; however, they are less rigidly tied to water than are otters. They are known to utilise every kind of waterway from tiny upland streams to broad lowland rivers, canals, ponds, lakes, reservoirs, estuaries, and even rocky seashores. As generalist predators, their diet very much depends on habitat and the time of year. Mammals, birds, fish and invertebrates all feature in variable proportions. Mink are most active at night or around dawn or dusk.

American mink first escaped from fur farms and began to establish itself in the wild in Ireland during the 1950s. It caused great alarm when it became clear that it could not be eradicated, but its spread, although undesirable, has not been the total catastrophe that was originally feared.

HEDGEHOG, GRAINNEÓG, *ERINACEUS EUROPAEUS*

The hedgehog inhabits open deciduous woodland or open country where sufficient cover is available. It is to be found in agricultural areas, gardens, parks and city suburbs. A mainly nocturnal, slow-moving animal, it feeds on a wide variety of invertebrates such as caterpillars, beetles, earthworms, slugs, earwigs and millipedes. It is also known to eat birds, their eggs, small mammals and carrion. Although believed to be scarce early last century, it now appears to be common in Ireland.



PYGMY SHREW, LUCH FÉIR/DALLÓG FHRAOIGH, *SOREX MINUTUS*

The pygmy shrew is Ireland's smallest mammal and it has the shortest lifespan. It is widespread in all types of habitat with plentiful ground cover. It eats small invertebrate prey such as spiders, beetles and insect larvae. It is predated on mainly by owls.

WOOD MOUSE, LUCH (LUCHÓG) FHÉIR, *APODEMUS SYLVATICUS*

The wood mouse occurs in a variety of habitats but prefers areas where the cover is fairly dense. As a digging animal its distribution tends to be influenced somewhat by soil suitability. The diet of the wood mouse is dominated by seeds but when this food source is in short supply, such as in spring and early summer they eat arthropods, green plant material, roots, berries, nuts, fruit, insects, and even the bodies of other mice and birds.

DAUBENTON'S BAT, LALTÓG UISCE, *MYOTIS DAUBENTONI*

Daubenton's bat is generally considered to be an animal of low-lying, flat, open, wooded country with water bodies. In Ireland most of its roosts are found under bridges but it also uses buildings, caves and trees. Daubenton's bat has a characteristic flight pattern close to the surface of slow-flowing or still water. It exploits the rich insect life around the banks of lakes, ponds and rivers. It flies low, hunting just above the water surface, snatching the insects that are attracted to the water surface. It usually emerges from its roost about 30 minutes or an hour after sunset.

COMMON PIPISTRELLE, LALTÓG FHEASCRACH, *PIPISTRELLUS PIPISTRELLUS*

AND

SOPRANO PIPISTRELLE, LALTÓG FHEASCRACH SOPRÁNACH *PIPISTRELLUS PYGMAEUS*

The soprano pipistrelle has only recently been distinguished from the common pipistrelle. The main difference between them is the frequency of their hunting calls (55 and 45 kHz respectively). It is very difficult to tell the two species apart.

Both are widespread and abundant. The soprano pipistrelle is probably our smallest bat and the common pipistrelle the second smallest. They emerge after dusk and may hunt for up to four hours a night.

LEISLER'S BAT, LALTÓG LEISLER, *NYCTALUS LEISLERI*

Ireland has Europe's largest population of Leisler's bat, and it is Ireland's largest bat. They emerge from the roosts early in the evening at or just before sunset. They hunt mainly over open deciduous and coniferous woodland and scrub areas. Leisler's bat usually roosts in old mature oak trees, which contain holes. In recent years, the erection of bat boxes (artificial roost units) has proved very successful; often the first evidence of a particular species being in an area has come from them.

NATTERER'S BAT, LALTÓG NATTEREIR, *MYOTIS NATTERERI*

Natterer's bat, although widespread in Ireland, is not abundant. It is one of Ireland's smaller bats, it is also one of the rarest and least known. It is generally considered to be a forest or woodland animal and roosts in tree-holes. They usually emerge about 45–60 minutes after sunset and may be seen flying moderately fast around trees or in the woodland canopy.

BIRDS OF BRACKLOON

Woodlands are very important habitats for birds, providing a source of food, a secure place in which to build their nests, and shelter from predators and inclement weather. The factors influencing the density of birds and diversity of species within woodlands include tree species, age and density of trees and the area covered by the habitat. The density of the ground cover will also affect bird species present, with some species preferring woodland with a dense shrub layer. Changes in management practices, e.g. felling, understorey clearance and grazing will impact upon bird species and populations. The dynamic nature of woodland development at Brackloon influences which species are present in the wood. Environmental changes will also affect bird communities and, as such, birds are good indicators of environmental change.

Many of the common woodland birds can be seen at Brackloon, along with some not normally associated with this habitat. Most of the birds present in the wood prefer the more mature semi-natural woodland vegetation. In all, 41 bird species were recorded at Brackloon. Eight of these, however, were recorded flying over, two were recorded in the fields outside the wood and a further three were confined to the river habitat. Therefore, a total of 28 species, including seven migrant species, were associated directly with the woodland habitat. Fifty-one different species of bird have been recorded in woods throughout Ireland. Brackloon is therefore species-rich in terms of number of species present. Wren, robin, blackbird, coal tit and blue tit are the most abundant bird species in the wood. During the summer the wren is the most abundant species in Brackloon, while in winter, the robin is most abundant.

Most of the bird species recorded at Brackloon are opportunistic generalists rather than woodland specialist species. A notable exception is the long-eared owl, which was also the only typically nocturnal species recorded on the dusk transects. This was also the only time when grasshopper

BRACKLOON WOOD BIRD SURVEY

A transect survey method was chosen to sample the bird community at Brackloon. A transect 2,700 m was marked out along pre-existing forest roads and subdivided into 100 m sections. All birds encountered, either seen or heard, while walking the transects, were recorded and allocated to one of four categories: (i) within 25 m on either side of the transect line, (ii) between 25 m and 100 m on either side of the transect line, (iii) more than 100 m on either side of the transect line and (iv) birds in flight (at any distance). All lateral distances were estimated at right angles to the transect line. The section of the Owenwee River bordering the woodland was surveyed separately from the main survey. This was carried out by walking the river bank and recording any riparian species.

Both winter and summer surveys were carried out. For the summer survey, the wood was visited twice; early in the breeding season (early May) to record resident and early migrant species, and later in the season (mid June) to record late-arriving species or those that were not active during the first visit. In the winter survey, two visits were also made to the wood (late January and early February) to estimate the winter migrant species. Surveying began approximately one hour after dawn and finished before midday. Dusk surveys were also conducted to detect crepuscular and nocturnal species.

warblers were detected. Species richness in Brackloon is increased by the river, which attracts the riparian species dipper, grey wagtail and mallard, in addition to snipe and water rail.

Blackcap was most abundant in the more mature regenerating woodland and goldcrest was most abundant in stands of mature conifers, although both these species occurred elsewhere in the wood. Regenerating clearfell patches in the wood have attracted species not normally associated with mature woodland in Ireland, such as willow warbler, grasshopper warbler and meadow pipit. Their presence has only been recorded in these areas. As maturation occurs and the regenerating clearfell patches become established, these species will most likely disappear, or at least be confined to the edges of the woodland.

Future changes in vegetation composition at Brackloon may also accommodate more woodland specialist species such as the wood warbler. Retention of lying and standing deadwood, snags, logs and dead branches, will provide additional nest sites for those specialist species associated with mature semi-natural woodland that use holes in trees for breeding.

WREN, DREOILÍN, *TROGLODYTES TROGLODYTES*

The wren is one of the most widespread and abundant of birds in Ireland. It is easily recognised by its small size and cocked tail, but its size and sombre plumage makes it difficult to detect. It commonly breeds in a wide variety of habitats, including woodlands, gardens, meadows, heathland, or anywhere with plentiful low cover. Woodland is a favourite haunt, especially with dense undergrowth. Although the wren is very abundant in woodland its scientific name Troglodytes troglodytes means ‘a cave dweller’. For such a small bird, both its song and its alarm calls are surprisingly loud and shrill. It nests between April and July. Whenever food is abundant and the weather is favourable the wren rears two broods. It searches for insects and spiders on or near the ground. During extremely cold weather, flocks of wrens will roost huddled together in a bundle, sharing body heat, which a small bird can lose rapidly on a cold night.

ROBIN, SPIDEOG, *ERITHACUS RUBECULA*

The robin generally nests in forest with dense undergrowth and in scrub, gardens, hedgerows and parks. It is the most familiar and popular of garden and woodland birds. The robin is one of the easiest European birds to identify, its red face distinguishing it from other red-breasted birds. In winter, northern European robins migrate to southern Europe. Other populations are resident. It feeds on insects and berries and moves over the ground hopping vigorously. It is an upright plump little bird and is confident and trusting with humans. Its song is one of the first to be heard in winter, as it proclaims its territorial rights.

BLUE TIT, MEANTÁN GORM, *PARUS CAERULEUS*

Although the blue tit is a frequent visitor to gardens in both winter and summer, it is really a woodland bird, commonly breeding in deciduous woods. Blue tits nest any time from mid-April to late June, depending on the availability of food. It feeds on insects, spiders and other small animals. It feeds in flocks of up to 30 in winter, often with other species of tit. It has a bright blue crown and its wings and tail are blue.

COAL TIT, MEANTÁN DUBH, *PARUS ATER*

The coal tit prefers coniferous trees but is fairly common in deciduous woodland, gardens and parks. Although it is widely distributed throughout the British Isles, it was very scarce in parts of western Ireland. However, it has increased and extended its range due to afforestation. It is a gregarious bird and often associates with other tits outside of the breeding season.

BLACKBIRD, LON DUBH, *TURDUS MERULA*

One of the most familiar birds in Europe, the blackbird is common in woodlands fields and gardens. The male is easily recognised by its jet-black plumage and yellow bill and eye-ring. The female is recognised by the uniformly brown plumage. It takes a wide range of food including insects worms, fruit and berries. It sings from a well-visible songpost and its song is very melodic and pleasing. The blackbird is highly territorial.

WILLOW WARBLER, CEOLAIRE SAILÍ, *PHYLLOSCOPUS TROCHILUS*

The willow warbler, a very common tiny summer visitor, flies all the way from Africa to rear its young in Europe. It spends the summer in woodland, particularly oak woodland, where it hunts for insects among the leaves. Like other warblers it is more often heard than seen.

Although common in oak wood they colonise any wooded or shrub area where the canopy is not dense. In some areas they seem to prefer birch wood to oak wood. It is the most common and widespread warbler.

SNIPE, NAOSCACH, *GALLINAGO GALLINAGO*

This wader is a shy secretive bird, most likely to be seen when flushed, flying off in a zigzag pattern, with its long straight bill pointed slightly downwards. Its habitat is flood meadows, grassland, marshland and bogs. It feeds mainly on worms but also molluscs, insects and other invertebrates.

LONG-EARED OWL, CEANN CAIT, *ASIO OTUS*

The long-eared owl is the most common owl in Ireland but is seldom seen as it roosts close to the trunks of trees. It is a medium-sized owl, which looks long and thin, with buff brown plumage with darker brown streaks and orange eyes. It has long head feathers known as ear tufts, which are held erect when nervous.

The long-eared owl hunts over open landscapes but nests and roosts in deciduous woodlands and coniferous plantations. It is a nocturnal, predatory bird emerging at night to feed on young birds and a wide range of small mammals, including mice, rats and shrews. The male has a long low drawn-out "oo-oo-oo" call and young birds make a loud and squeaky call which sounds like an unoiled hinge. It is more frequent in the east than the west of the country, and it is estimated that there may be 1,000–3,500 pairs in Ireland.

THE FUTURE?

Native woodlands are a valuable part of our heritage, which if lost can never be fully regained. They are among our most beautiful and important habitats, supporting a wide range of plant and animal species, ranging from large majestic oak trees to tiny insects. Often associated with these woodlands also are features of historical and archaeological importance.

Brackloon Wood has survived the last 10,000 years. Throughout the course of its long history it has undergone many perturbations. It has withstood clearances for agriculture, periods of intense exploitation and, in recent decades, part conversion to a coniferous plantation.

Substantial archives of land use history and changes are preserved in the landscape, vegetation, soils and sediments of the wood. Historical documents, including early travellers' accounts, estate records and maps, contain details of its recent history. Native woodlands have much to tell us about our past. They can also provide insights into long-term ecosystem processes and therefore have an important role to play in informing and guiding present-day forest management practices.

While Brackloon has survived the last 10,000 years, its future and that of other remnants of native woodlands throughout the country is by no means assured without careful informed long-term management. Management activities must recognise that these ecosystems are in a constant state of change, not always apparent within the perspective of human life spans.

Responsibility for Brackloon's continued survival now rests with us. We have the knowledge and more resources than ever before to take care of it. Happily steps are being taken to safeguard its future. The integrated approach adapted to the conservation and preservation of Brackloon, involving management, research and monitoring is central to the future viability of the wood. The role of local

communities in the preservation of these woodlands is paramount. At Brackloon the input of the community and their appreciation of this important resource are invaluable.

Brackloon Wood is currently being managed to ensure its sustainability and longevity and to maximise its biological diversity. Conditions for regeneration to succeed have been provided and planting with native trees has occurred. Young trees are growing alongside old trees. The process of recreating the original wooded landscape is underway. Ecological, environmental and amenity benefits will be immeasurable. When you walk through the wood, remember its past, evidence of which remains all around you and remember it is home to many creatures.

At Brackloon the future is bright. A new chapter in the story of the wood is just beginning!

APPENDIX

Plant species mentioned in text

Common name	Irish name	Latin name
Sycamore	Seiceamar	*Acer pseudoplatanus*
Horse chestnut	Crann cnó-capaill	*Aesculus hippocastanum*
Velvet bent	Feorainn shlim	*Agrostis canina*
Alder	Fearnóg	*Alnus glutinosa*
Sweet vernal grass	Féar cumhra	*Anthoxanthum odoratum*
Silver birch	Beith gheal	*Betula pendula*
Downy birch	Beith chlúmhach	*Betula pubescens*
Hard fern	Raithneach chrua	*Blechnum spicant*
Flea sedge	Cíb dhreancaide	*Carex pulicaris*
Remote sedge	Cíb scartha	*Carex remota*
Wood sedge	Cíb choille	*Carex sylvatica*
Narrow-leaved helleborine	Cuaichín Caol	*Cephalantera longifolia*
Enchanter's nightshade	Fuinseagach	*Circaea lutetiana*
Pignut	Cúlarán	*Conopodium majus*
Hazel	Coll	*Corylus avellana*
Hawthorn	Sceach geal	*Cratageus monogyna*
Marsh hawk's-beard	Lus corraigh	*Crepis paludosa*
Foxglove	Méaracáin phúcaí	*Digitalis purpurea*
Broad buckler fern	Raithneach leathan	*Dryopteris dilatata*
Crowberry	Lus na feannóige	*Empetrum nigrum*
Rosebay willowherb	Saileachán francach	*Epilobium angustifolium*
Water horsetail	Eireaball capaill uisce	*Equisetum fluviatile*
Beech	Fea	*Fagus sylvatica*
Giant fescue	Feisciú capaill	*Festuca gigantea*
Meadowsweet	Airgead luachra	*Filipendula ulmaria*
Ash	Fuinseóg	*Fraxinus excelsior*
Herb robert	Earball rí	*Geranium robertianum*
Ivy	Eidhneán	*Hedera helix*
Yorkshire fog	Féar an chin bháin	*Holcus lanatus*
Bluebell	Coinnle corra	*Hyacinthoides non-scripta*

Common name	Irish name	Latin name
Holly	Cuileann	*Ilex aquifolium*
Yellow iris	Feileastram	*Iris pseudacorus*
Soft rush	Luachair bhog	*Juncus effusus*
Hard rush	Luachair chrua	*Juncus inflexus*
Juniper	Aiteal	*Juniperus communis*
Honeysuckle	Táthfhéithleann	*Lonicera periclymenum*
Great wood-rush	Ollghiúnach	*Luzula sylvatica*
Cow wheat	Lus an tsagairt	*Melampyrum pratense*
Wood melic	Meilic	*Melica uniflora*
Watermint	Mismín uisce	*Mentha aquatica*
Wood sorrel	Samhradh choille	*Oxalis acetosella*
Norway spruce	Sprús Lochlannach	*Picea abies*
Sitka spruce	Sprús Sitceach	*Picea sitchensis*
Lodgepole pine	Péine contórtach	*Pinus contorta*
Scots pine	Péine Albanach	*Pinus sylvestris*
Plantain	Slánlus	*Plantago* spp.
Polypody	Scim choiteann	*Polypodium vulgare*
Aspen	Crann creathach	*Populus tremula*
Tormentil	Néalfhartach	*Potentilla erecta*
Primrose	Sabhaircín	*Primula vulgaris*
Douglas fir	Giúis Dhúghlais	*Pseudotsuga menziesii*
Bracken	Raithneach	*Pteridium aquilinium*
Sessile oak	Dair neamhghasánach	*Quercus petraea*
Pedunculate oak	Dair ghallda	*Quercus robur*
Rhododendron	Ródaideandrón fiáin	*Rhododendron ponticum*
Bramble	Driseog	Rubus spp.
Sheep's sorrel	Samhadh caorach	*Rumex acetosella*
Dock	Copóg	*Rumex* spp.
Willow	Saileach	*Salix cinerea*
Elder	Tromán	*Sambucus nigra*
Rowan/Mountain ash	Caorthann	*Sorbus aucuparia*
Yew	Iúr	*Taxus baccata*
Wych elm	Leamhán sléibhe	*Ulmus glabra*
Bilberry	Fraochán	*Vaccinium myrtillus*
Guelder rose	Caorchon	*Viburnum opulus*
Early dog-violet	Sail chuach	*Viola reichenbachiana*
Common dog-violet	Sailchuach chon	*Viola riviniana*

Mammals of Brackloon Wood

COMMON NAME	IRISH NAME	LATIN NAME
Badger	Broc	*Meles meles*
Brown long-eared bat	Laltóg fhad-chluasach	*Plecotus auritus*
Brown rat	Francach donn	*Rattus norvegicus*
Common pipistrelle	Laltóg fheascrach	*Pipistrellus pipistrellus, 45 kHz*
Daubenton's bat	Laltóg uisce	*Myotis daubentoni*
Fallow deer	Fia buí	*Dama dama*
Fox	Sionnach/Madra rua	*Vulpes vulpes*
Hare	Giorria	*Lepus timidus*
Hedgehog	Grainneóg	*Erinaceus europaeus*
Leisler's bat	Laltóg Leisler	*Nyctalus leisleri*
Mink	Minc Mhericeánach	*Mustela vison*
Natterer's bat	Laltóg Nattereir	*Myotis natterei*
Pine marten	Cat crainn	*Martes martes*
Pygmy shrew	Luch féir/Dallóg fhraoigh	*Sorex minutus*
Soprano pipistrelle	Laltóg fheascrach sopránach	*Pipistrellus pipistrellus, 55 kHz*
Stoat	Easóg	*Mustela erminea*
Wood mouse	Luch (luchóg) fhéir	*Apodemus sylvaticus*

Birds of Brackloon Wood

COMMON NAME	IRISH NAME	LATIN NAME	LOCATION OBSERVED	STATUS	SEASON RECORDED
Blackbird	Lon dubh	*Turdus merula*		R	S,W
Blackcap	Caipín dubh	*Sylvia atricapilla*		M	S
Blue tit	Meantán gorm	*Parus caeruleus*		R	S,W
Bullfinch	Corcrán coille	*Pyrrhula pyrrhula*		R	S
Chaffinch	Rí rua	*Fringilla coelebs*		R	S,W
Chiffchaff	Tiuf-teaf	*Phylloscopus collybita*		M	S
Coal tit	Meantán dubh	*Parus ater*		R	S,W
Cormorant	Broigheall	*Phalacrocorax carbo*	F	R	W
Cuckoo	Cuach	*Cuculus canorus*		M	S
Dipper	Gabha dubh	*Cinclus cinclus*	O	R	S
Dunnock	Donnóg	*Prunella modularis*		R	S,W
Goldcrest	Cíorbhuí	*Regulus regulus*		R	S,W
Goldfinch	Lasair choille	*Carduelis carduelis*	F	R	W
Grasshopper warbler	Ceolaire casarnaí	*Locustella naevia*	M		S
Great tit	Meantán mór	*Parus major*		R	S,W
Grey wagtail	Glasóg liath	*Motacilla cinerea*	O	R	S,W
Hooded crow	Caróg liath	*Corvus corone cornix*		R	S,W
Jackdaw	Cág	*Corvus monedula*	F	R	S,W
Jay	Scréachóg	*Garrulus glandarius*	R		S,W
Linnet	Gleoiseach	*Carduelis cannabina*	F	R	W
Long-eared owl	Ceann cait	*Asio otus*		R	W
Long-tailed tit	Meantánerrfhada	*Aegithalos caudatus*		R	S,W
Magpie	Snag breac	*Pica pica*		R	S,W
Mallard	Lacha fhiáin	*Anas platyrhynchos*	O	R	S,W
Mistle thrush	Liatráise	*Turdus viscivorus*		R	S,W
Peregrine	Fabhcún gorm	*Falco peregrinus*	F	R	W
Pheasant	Piasún	*Phasianus colchicus*		R	S,W
Raven	Fiach dubh	*Corvus corax*	F	R	S,W
Redwing	Deargán sneachta	*Turdus iliacus*	F	M	W
Robin	Spideog	*Erithacus rubecula*		R	S,W
Rook	Rúcach	*Corvus frugilegus*	F	R	W
Snipe	Naoscach	*Gallinago gallinago*	OSA	R	W
Song thrush	Smólach ceoil	*Turdus philomelos*		R	S,W
Sparrowhawk	Spióróg	*Accipiter nisus*		R	S,W
Spotted flycatcher	Cuilire liath	*Musciapa striata*		M	S
Treecreeper	Snag	*Certhia familiaris*		R	S,W
Water rail	Rálóg uisce	*Rallus aquaticus*	OSA	R	W
Willow warbler	Ceolaire sailí	*Phylloscopus trochilus*		M	S
Woodcock	Creabhar	*Scolopax rusticola*		R+M	W
Woodpigeon	Colm coille	*Columba palumbus*		R	S,W
Wren	Dreoilín	*Troglodytes troglodytes*		R	S,W

Location observed: O = river, F = flying over, OSA = outside survey area
Status: R = resident, M = migrant. Season: S = summer, W = winter

Surface invertebrates captured in pitfall trap at Brackloon Wood.

STAGE	CLASS	ORDER	SUB-ORDER	FAMILY	SPECIES	NUMBER
Adults:						
	Arachnida	Acari				322
		Aranaea				479
		Opiliones			*N. bimaculatum*	60
					Others	405
	Crustacea	Isopoda				163
	Chilopoda	Lithobiomorpha				9
		Geophilomorpha				0
	Diplopoda	Polydesmida				81
		Julida				120
		Glomerida				7
	Insecta	Coleoptera	Brachelytra	Staphylinidae		485
			Clavicornia	Silphidae		48
				Others		37
			Lamellicornia	Scarabaeidae		216
			Longicornia	Cerambycidae		4
			Rhynchophora	Curculionidae		4
			All others			43
		Collembola				470
		Diptera	Bracycera			20
			Cyclorrhapha			608
			Nematocera			15
		Hemiptera	Heteroptera			14
			Homoptera			26
		Hymenoptera	Apocrita			193
	Oligochaeta					92
	Gastropoda					107
Larvae:						
	Insecta	Coleoptera				117
		Diptera				68
		Hymenoptera				2
		Lepidoptera				30
Nymphs:						
	Insecta	Dermaptera				1

Carabid beetles recorded at Brackloon Wood

SPECIES	TOTAL NUMBER	%
Abax parallelepipedus	410	52.6
Carabus granulatus	61	7.8
Carabus nemoralis	20	2.6
Carabus problematicus	30	3.8
Cychrus caraboides	3	0.4
Leistus rufescens	5	0.6
Loricera pillicornis	1	0.1
Nebria brevicollis	5	0.6
Pterostichus madidus	92	11.8
Pterostichus melanarius	102	13.1
Pterostichus niger	46	5.9
Pterostichus nigrita	2	0.3
Pterostichus strenuus	2	0.3
Trechus obtusus	1	0.1

Botanical Species List for Brackloon Wood

FERNS

Athyrium filix-femina
Blechnum spicant
Dryopteris affinis
Dryopteris dilatata
Dryopteris filix-mas
Dryopteris pseudomas
Equisetum fluviatile
Hymenophyllum wilsonii
Osmunda regalis
Phyllitis scolopendrium
Polypodium vulgare
Pteridium aquilinum

DICOTYLEDENOUS PLANTS

Acer campestris
Acer pseudoplatanus
Achillea millefolium
Aesculus hippocastanum
Agrimonia eupatoria
Ajuga reptans
Alnus glutinosa
Anagalis arvensis
Bellis perennis
Betula pendula
Betula pubescens
Calluna vulgaris
Caltha palustris
Campanula rotundifolia
Cardamine flexuosa
Cardamine pratensis
Centaurea nigra
Cerastium fontanum
Chrysosplenium oppositifolium
Circaea lutetiana
Circium palustre
Circium vulgare
Corylus avellana
Crataegus monogyna
Crepis paludosa
Cytisus scoparius
Daboecia cantabrica
Digitalis purpurea
Drosera anglica
Epilobium angustifolium
Epilobium brunescens
Epilobium montanum
Epilobium parviflorum
Erica cinerea
Erica tetralix
Euphrasia arctica borealis
Fagus sylvatica
Filipendula ulmaria
Fragaria vesca
Fraxinus excelsior
Galium aparine
Galium palustre
Galium saxatile
Galium verum
Geranium robertianum
Geum rivale
Geum urbanum
Hedera helix
Heracleum sphondylium
Hieracium pilosellum
Hieracium umbellatum
Hyacynthoides non-scriptus
Hypericum androsaemum
Hypericum pulchrum
Ilex aquifolium
Lathyrus pratensis
Lonicera periclymenum
Lotus corniculatus
Lysimachia nemorum
Lythrum salicaria
Lychnis flos-cuculi
Melampyrum pratensis
Myrica gale
Oxalis acetosella
Plantago lanceolata
Plantago major
Potentilla erecta

Primula vulgaris
Prunus spinosa
Menta aquatica
Montia fontana
Pedicularis sylvatica
Polygala serpyllifolia
Quercus petraea
Potentilla anserina
Ranunculus ficaria
Ranunculus scleratus
Rhododendron ponticum
Rosa canina
Rubus idaeus
Salix cinerea oleifolia
Salix caprea
Sanicula europaea
Saxifraga spathularis
Sedum acre
Potentilla sterilis
Prunella vulgaris
Ranunculus acris
Rubus mucronatulus
Senecio aquaticus
Solidago virgurea
Stellaria graminea
Thymus praecox
Senecio jacobaea
Sorbus aucuparia
Stachys sylvatica
Stellaria holostea
Succisa pratensis
Symphoricarpos rivularis
Taraxacum officinale
Teucrium scordonia
Trifolium pratense
Trifolium repens
Ulex europaeus
Ulmus glabra
Umbilicus rupestris
Urtica dioica
Veronica chamaedrys
Vaccinium myrtillus
Valeriana officinalis
Veronica officinalis
Viburnum opulus
Viola reichenbachiana
Viola riviniana

MONOCOTYLEDENOUS PLANTS

Agrostis canina
Agrostis capillaris
Agrostis tenuis
Aira praecox
Anthoxanthum odoratum
Arrhenatherum elatius
Arum maculatum
Brachypodium sylvaticum
Bromus hordeaceus
Carex flacca
Carex laevigata
Carex nigra
Carex pulicaris
Carex remota
Carex rostrata
Carex sylvatica
Cephalanthera longifolia
Cynosurus cristatus
Dactylis glomerata
Dactylorhiza maculata
Deschampsia caespitosa
Festuca altissima
Festuca ovina
Holcus lanatus
Holcus mollis
Hyacinthoides non-scripta
Iris pseudacorus
Juncus conglomeratus
Juncus effusus
Luzula multiflora
Luzula sylvatica
Melica uniflora
Millium effusum
Molinia caerulea
Poa annua
Poa pratensis
Potamogeton perfoliatus
Potamogeton polygonifolius
Tritonia x crocosmiflora

HEPATICS

Bazzania tricrenata
Bazzania trilobata
Calypogeia fissa
Calypogeia muellerana
Cephalozia bicuspidata
Chiloscyphus polyanthus
Colura calyptrifolia
Conocephalum conicum
Diplophyllum albicans
Drepanolejeunea hamatafolia
Frullania dilatata
Frullania fragifolia
Frullania microphylla
Frullania tamarisci
Frullania teneriffae
Gymnomitrium crenulatum
Harpalejeunea ovata
Lejeunea cavifolia
Lejeunea lamacerina
Lejeunea patens
Lejeunea ulicina
Lepidozia cupressina
Lepidozia reptans
Lophocolea bidentata
Lophozia ventricosa
Lunularia cruciata
Marchesinia mackaii
Marsupella emarginata
Metzgeria fruticulosa
Metzgeria furcata
Mylia taylorii
Nardia scalaris
Nowellia curvifolia
Pellia epiphylla
Plagiochila asplenioides
Plagiochila porelloides
Plagiochila punctata
Plagiochila spinulosa
Radula complanata
Saccogyna viticulosa
Scapania nemorea
Scapania umbrosa
Scapania undulata
Trichocolea tomentella

MOSSES

Andraea rothii
Aulocomium palustre
Brachythecium rutabulum
Breutelia chrysocoma
Bryum capillare
Bryum pseudotriquetrum
Calliergon cuspidatum
Campylium stellatum
Campylopus atrovirens
Campylopus introflexus
Campylopus paradoxus
Ceratodon purpureus
Cinclidotus fontinaloides
Cratoneuron commutatum
Ctenidium molluscum
Dicranella heteromalla
Dicranella varia
Dicranum majus
Dicranum scoparium
Eurhynchium praelongum
Eurhynchium striatum
Eurhynchium swartzii
Fissidens osmundoides
Fissidens taxifolius
Fontinalis antipyretica
Funaria hygrometrica
Hedwigia ciliata
Homalothecium sericeum
Hookeria lucens
Hylocomium brevirostre
Hylocomium splendens
Hypnum cupressiforme
Hypnum jutlandicum
Isothecium myosuroides
Isothecium myurum
Leucobryum glaucum
Mnium hornum
Neckera complanata
Neckera crispa
Plagiomnium rostratum
Plagiomnium undulatum
Plagiothecium undulatum
Pleurozium schreberi
Pogonatum aloides
Pogonatum urnigerum

Polytrichum commune
Polytrichum piliferum
Pseudoscleropodium purum
Racomitrium aquaticum
Racomitrium fasciculare
Racomitrium lanuginosum
Rhizomnium punctatum
Rhytidiadelphus loreus
Rhytidiadelphus squarrosus
Rhytidiadelphus triquetrus
Sphagnum auriculatum
Sphagnum palustre
Sphagnum papillosum
Sphagnum quinquefarium
Thamnobryum alopecurum
Thuidium tamariscinum
Tortula laevipila
Ulota crispa
Ulota hutchinsiae
Ulota phyllantha
Zygodon viridissimus viridissimus

ALGAE & CYANOBACTERIA
Elliptochloris bilobata
Nannochloris normandinae
Trebouxia erici
Trebouxia sp. (in Parmeliaceae)
Trentepohlia aurea
Trentepohlia umbrina
Nostoc muscorum
Nostoc punctiforme

BASIDIOMYCETES
Agaricus langei
Amanita citrina
Amanita muscaria
Amanita rubescens
Armillaria mellea
Asterophora parasitica
Boletus edulis
Cantharellus cibarius
Cantharellus infundibuliformis
Clavaria vermicularis
Clavulina cristata
Clitocybe ditopa
Clitocybe infundibuliformis
Clitocybe nebularis
Collybia dryophila
Collybia inolens
Collybia maculata
Collybia marasmioides
Conocybe brunneola
Conocybe tenera
Coprinus cinereus
Coprinus micaceus
Coprinus niveus
Coprinus plicatilis
Coprinus radiatus
Coriolus versicolor
Cortinarius acutus
Cortinarius alboviolaceus
Cortinarius bolaris
Cortinarius brunneus
Cortinarius callisteus
Cortinarius caninus
Cortinarius cotoneus
Cortinarius decipiens
Cortinarius elatior
Cortinarius erythrinus
Cortinarius helvelloides
Cortinarius hemitrichus
Cortinarius hinnuleus
Cortinarius largus
Cortinarius myrtillinus
Cortinarius obtusus
Cortinarius ochroleucus
Cortinarius paleaceus
Cortinarius purpurascens
Cortinarius rigidus
Cortinarius torvus
Cortinarius trivialis
Crepidotus variabilis
Cyathus striatus
Cystoderma amianthum
Entoloma nidorosum
Entoloma rhodopolium
Fistulina hepatica
Galerina hypnorum
Galerina sphagnorum
Hebeloma crustuliniforme
Hebeloma fastibile
Hydnum repandum

Hydnum rufescens
Hygrocybe ceracea
Hygrocybe chlorophana
Hygrocybe coccinea
Hygrocybe laeta
Hygrocybe miniata
Hygrocybe nivea
Hygrocybe psittacina
Hygrocybe virginea
Hypholoma epixanthum
Hypholoma fasciculare
Hypholoma sublateritium
Inocybe geophylla
Inocybe geophylla var. lilacina
Inocybe petiginosa
Laccaria amethystea
Lactarius aurantiacus
Lactarius blennius
Lactarius chrysorrheus
Lactarius cimicarius
Lactarius deliciosus
Lactarius glyciosmus
Lactarius hysginus
Lactarius insulsus
Lactarius mitissimus
Lactarius necator
Lactarius piperatus
Lactarius pubescens
Lactarius quietus
Lactarius serifluus
Lactarius subdulcis
Lactarius torminosus
Lactarius uvidus
Lactarius vellereus
Lactarius vietus
Leccinum scabrum
Leptoglossum acerosum
Leptonia sericella
Leptonia serrulata
Lycoperdon perlatum
Lycoperdon pyriforme
Marasmius ramealis
Marasmius rotula
Mycena aetites
Mycena amygdalina
Mycena corticola
Mycena epipterygia
Mycena flavoalba
Mycena galericulata
Mycena galopoda var. nigra
Mycena galopus
Mycena phyllogena
Mycena polygramma
Mycena pura
Mycena tenerrima
Naucoria escharoides
Omphalina ericetorum
Oudemansiella mucida
Panaeolus campanulatus
Panaeolus sphinctrinus
Paxillus involutus
Phlebia radiata
Piptoporus betulinus
Pluteus cervinus
Polyporus squamosus
Psathyrella atomata
Psathyrella bifrons
Psathyrella corrugis
Psathyrella fibrillosa
Psathyrella gossypina
Psathyrella gracilis
Psathyrella stercoraria
Psathyrella velutinum
Psilocybe crobula
Psilocybe inquilina
Psilocybe semilanceata
Rhodophyllus griseorubellus
Russula atropurpurea
Russula cyanoxantha
Russula fellea
Russula fragilis
Russula galochroa
Russula lepida
Russula lutea
Russula nigricans
Russula nitida
Russula ochroleuca
Russula puellaris
Russula pulchella
Russula sardonia
Russula vesca
Russula violacea

Russula xerampelina
Scleroderma citrinum
Scleroderma verrucosum
Sphaerobolus stellatus
Stereum rugosum
Stropharia aeruginosa
Stropharia semiglobata
Stropharia squamosa
Suillus bovinus
Suillus grevillei
Tricholoma album
Tricholoma flavobrunneum
Tricholoma saponaceum
Tricholoma virgatum
Tricholomopsis rutilans
Tubaria furfuracea
Xerocomus badius
Xerocomus subtomentosus

BASIDIOMYCETES (old names)
Calocera stricta
Cantharellus muscigenus
Clavaria kunzei
Collybia platyphylla
Corticium lacteum
Cortinarius camurus
Cortinarius castaneus
Cortinarius dolabratus
Cortinarius glaucopus
Cortinarius impennis
Cortinarius leucopus
Cortinarius penicillatus
Cyphella muscigena
Flammula tricholoma
Hypholoma hydrophilum
Inocybe rimosa
Irpex obliquus
Lycoperdon umbrinum
Mycena discopoda
Mycena setosa
Mycena tenuis
Naucoria melinoides
Pholiota marginata
Pholiota mutabilis
Pistillaria puberula
Polyporus caesius
Poria medullapanus
Russula fragilis var. violacea
Stereum spadiceum

BASIDIOMYCETES (additions)
Biatoropsis usnearum
Exidia albida
Hygrophorus pratensis
Mycena pseudocorticola
Tremella mesenterica
Tremella pertusariae

BASIDIOMYCETES (Rusts & Smuts)
Melampsora hypericorum
Phragmidium violaceum
Puccinia graminis
Puccinia menthae
Puccinia umbilici
Ustilago hydropiperis
Ustilago violacea

ASCOMYCETES
Apiocea chrysosperma
Ascobolus furfuraceus
Ascocoryne sarcoides
Bisporella citrina
Bulgaria inquinans
Chlorosplenium aeruginascens
Coccomyces coronatus
Diatrype disciformis
Diatrype stigma
Diatrypella quercina
Geoglossum microsporum *
Helvella macropus
Hymenoscypha daedaleae
Hymenoscyphus herbarum
Hymenoscyphus virgultorum
Hypoxylon fuscum
Hysterium pulicare
Lachnum apalum
Lachnum ciliare
Lachnum niveum
Lachnum virgineum
Lasiosphaeria ovina
Leotia lubrica
Mollisia cinerea

Mycosphaerella depazeiformis
Mycosphaerella punctiformis
Orbilia leucostigma
Otidea cochleata
Pezizella parile *
Pleospora herbarum
Rhopographus filicinus
Rhytisma acerinum
Rutstroemia firma
Sclerotinia fuckeliana
Terreria cladophilum
Trochila ilicina
Ustulina deusta
Valsa lata *
Xylaria hypoxylon

ASCOMYCETES (Lichen forming and lichenicolous species)
Abrothallus bertianus
Abrothallus microspermus
Abrothallus usneae
Acrocordia gemmata
Agonimia octospora
Arthonia cinnabarina
Arthonia didyma
Arthonia graphidicola
Arthonia ilicina
Arthonia muscigena
Arthonia punctiformis
Arthonia radiata
Arthonia spadicea
Arthonia thelotrematis
Arthonia vinosa
Arthopyrenia antecellans
Arthopyrenia carneobrunneola
Arthopyrenia lapponina
Arthopyrenia punctiformis
Aspicilia caesiocinerea
Aspicilia cinerea
Bacidia arceutina
Bacidia inundata
Bacidia viridifarinosa
Bactrospora corticola
Baeomyces rufus
Biatorina epixanthoides
Biatorina sphaeroides
Buellia aethalea
Buellia griseovirens
Caloplaca ferruginea
Catillaria atropurpurea
Catillaria nigroclavata
Catillaria pulvurea
Celothelium ischnobelum
Chrysothrix candelaris
Cladonia chlorophaea
Cladonia coniocraea
Cladonia macilenta
Cladonia polydactyla
Cladonia portentosa
Cladonia pyxidata
Cladonia rangiformis
Cladonia squamosa
Cladonia subcervicornis
Coccotrema citrinescens
Cystocoleus ebeneus
Degelia atlantica
Dermatocarpon luridum
Dimerella diluta
Dimerella lutea
Enterographa crassa
Enterographa hutchinsiae
Enterographa zonata
Ephebe lanata
Evernia prunastri
Fellhanera bouteillei
Fuscidea cyathoides
Fuscidea lightfootii
Graphina anguina
Graphis elegans
Graphis scripta
Gyalideopsis anastomosans
Haematomma elatinum
Haematomma ochroleucum
Herteliana taylorii
Heterodermia obscurata
Homostegia piggotii
Hypogymnia physodes
Hypogymnia tubulosa
Ionaspis lacustris
Japewia carrollii
Lecanactis abietina
Lecanora argentata

Lecanora carpinea
Lecanora chlarotera
Lecanora expallens
Lecanora gangaleoides
Lecanora jamesii
Lecanora polytropa
Lecidea fuscoatra
Lecidea hypnorum
Lecidea lactea
Lecidea plana
Lecidea sanguineoatra
Lecidella elaeochroma
Lecidella scabra
Lepraria lobificans
Lepraria umbricola
Leproloma vouauxii
Leptogium cyanescens
Leptogium lichenoides
Lobaria pulmonaria
Lobaria scrobiculata
Loxospora elatina
Megalospora tuberculosa
Melaspilea ochrothalamia
Micarea cinerea
Micarea hedlundii
Micarea leprosula
Micarea lignaria
Micarea peliocarpa
Micarea prasina
Mycoblastus sterilis
Mycoglaena myricae
Mycomicrothelia confusa
Mycoporum quercus
Nephroma laevigatum
Normandina pulchella
Ochrolechia androgyna
Ochrolechia dealbescens
Ochrolechia parella
Opegrapha atra
Opegrapha gyrocarpa
Opegrapha herbarum
Opegrapha ochrocheila
Opegrapha saxatilis
Opegrapha thelotrematis
Opegrapha vulgata
Pannaria conoplea
Pannaria pezizoides
Pannaria rubiginosa
Parmelia caperata
Parmelia conspersa
Parmelia crinita
Parmelia glabratula
Parmelia laevigata
Parmelia mougeotii
Parmelia perlata
Parmelia revoluta
Parmelia saxatilis
Parmelia sinuosa
Parmelia subaurifera
Parmelia sulcata
Peltigera collina
Peltigera horizontalis
Peltigera lactucifolia
Peltigera membranacea
Peltigera praetextata
Pertusaria albescens
Pertusaria amara
Pertusaria corallina
Pertusaria flavicans
Pertusaria flavida
Pertusaria hymenea
Pertusaria leioplaca
Pertusaria pertusa
Phaeographis smithii
Phlyctis argena
Phyllopsora rosei
Physcia aipolia
Placopsis gelida
Placynthiella uliginosa
Polychidium dendriscum
Porina chlorotica
Porina lectissima
Porpidia caesioatra
Porpidia macrocarpa
Porpidia tuberculosa
Pronectria anisospora
Pseudocyphellaria norvegica
Pyrenula macrospora
Pyrenula occidentalis
Pyrrhospora quernea
Ramalina farinacea
Rhizocarpon geographicum

Rhizocarpon lavatum
Rhizocarpon obscuratum
Schismatomma cretaceum
Skyttea nitschkei
Staurothele fissa
Stenocybe septata
Sticta canariensis
Sticta canariensis dufourii
Sticta fuliginosa
Sticta limbata
Sticta sylvatica
Thelotrema lepadinum
Tomasellia gelatinosa
Trapelia coarctata
Trapelia involuta
Trapeliopsis flexuosa
Trapeliopsis granulosa
Trapeliopsis pseudogranulosa
Usnea cornuta
Usnea flammea
Usnea fragilescens
Usnea subfloridana
Verrucaria aethiobola
Verrucaria hydrela
Xanthoria parietina
Zamenhofia rosei

MITOSPORIC FUNGI
Aspergillus herbariorum
Colletotrichum hederae
Cylindrium flavovirens
Doratomyces stemonitis
Hymenostilbe arachnophila
Sporochisma mirabile
Torula herbarum
Trichoderma viride *
Zygodemus fuscus *

MITOSPORIC FUNGI (on lichens)
Cornutispora lichenicola
Endophragmiella hughesii
Laeviomyces pertusariicola
Lichenoconium erodens
Phoma cytospora
Sclerococcum sphaerale
Vouauxiella lichenicola
Vouauxiella uniseptata
Xanthoriicola physciae

PHYCOMYCETES
Entomophthora americana
Pilobolus crystallinus

MYXOMYCETES
Arcyria cinerea
Arcyria denudata
Arcyria incarnata
Badhamia panicea
Badhamia utricularis
Calomyxa metallica
Ceratiomyxa fruticulosa
Comatricha laxa
Comatricha nigra
Craterium minutum
Cribaria argillacea
Cribaria cancellata
Didymium melanospermum
Didymium nigripes
Didymium squamulosum
Fuligo septica
Leocarpus fragilis
Lycogala epidendrum s lat
Mucilago crustacea
Physarium compressum
Physarium leucophaeum
Physarium nutans
Stemonitis fusca
Stemonitopsis typhina
Trichia affinis
Trichia botrytis
Trichia decipiens
Trichia varia

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