

REVIEW OF FOREST POLICY
FOR THE HERITAGE COUNCIL



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May 2008

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List of acronyms

CCF: continuous cover forestry

EU: European Union

FEPS: Forest Environmental Protection Scheme

FIMS: Forest Industry Mapping System

FSC: Forest Stewardship Council

GAA: Gaelic Athletic Association

IEEM: Institute of Ecology and Environmental Management

IFS: Indicative Forest Strategy

GIS: Geographic Information Systems

GPCs: Grant premium categories

PJ: Petajoules

LTR: Long term retention

MMAI: Maximum mean annual increment

NHA: Natural Heritage Area

NPWS: National Parks and Wildlife Service

NWS: Native Woodland Scheme

OWS: Old woodland sites (within Coillte estate)

SAC: Special Area of Conservation

SFM: Sustainable Forest Management

SIF: Society of Irish Foresters

SLIMF: Small and low intensity managed forests (an initiative of FSC)

SPA: Special Protection Area

Acknowledgements

The team wish to thank the many people who took time to make submissions or give expert advice. We also wish to acknowledge the important role of Woodlands of Ireland, and especially Dr. Declan Little, in instigating this review, and the Woodlands of Ireland Steering Group in giving feedback on a previous draft. Regina Daly's help with promoting the public consultation and for moderating the public meeting was invaluable. Thanks also to David Fallon for compiling the glossary, and to Kathy Hynes and Patrick Moore for taking notes of the discussion during the public meeting.

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EXECUTIVE SUMMARY

This review of Heritage Council forest policy was carried out by a team of six foresters and ecologists at the request of Woodlands of Ireland. The team was asked to review topics including:

- Forest policy, legislation, certification and incentives
- Species and site suitability
- Forest products and silvicultural systems
- Biodiversity
- Recreation
- Protection of water and soil
- Climate change
- International trends and markets, national trends and future forestry potential
- Forestry and the landscape
- Public perception and attitudes toward forestry
- Training and research needs
(See further Appendix 1).

The review was carried out by collating and analysing published, grey, and oral information relevant to forest management in Ireland. The emphasis was on science-based knowledge, but the team also drew on its considerable collective experience of working in the forestry sector. Submissions were sought from all interested parties, and a public meeting was held to present draft conclusions followed by discussion.

In the last decade, there has been a growing international trend toward recognition of all the functions forests provide to society. The multifunctional approach is the dominant thread in this review. Services forests provide to Irish society include not only timber and fuel, but space for outdoor recreation, landscapes to enjoy, and birdsong to hear. Cultural heritage, carbon sequestration, and conservation of species are other functions provided by forests. All of these functions deserve to be recognised and valued appropriately.

Irish forests are currently dominated by exotic conifer plantations with simple structures that are now part of our heritage, along with broadleaf plantations, native

woodland, grassland, and heath: the landscape created through millennia of land clearance, farming, building, and afforestation. This review supports an increase in the area of forest cover of the type suitable to the site and objectives, with strategic planning of forests considering biodiversity, ecological networks, and product transport. These forests should be managed by qualified professionals following multi-resource management plans. Irish forests need to be protected from both biotic threats and stress caused by climate change.

Six major themes are considered: multifunctional forestry, forest strategy, management of forests, making forests sustainable for owners, legislation and authorities, and training and research.

The main recommendations are:

1. A new National Strategic Plan for Forestry founded on the principles of multifunctional forestry.
2. Continued investment in the expansion of Ireland's forest estate, especially broadleaves and native woodlands, with a review of incentives and administration which support this expansion.
3. Increased delivery of multifunctional forest management, integrating social, environmental, and economic functions of forests on a national scale.
4. A new economic valuation system, which values the ecological, social, and economic functions of forests.
5. Retention of State forests in public ownership.
6. Action on threats to Ireland's forests such as invasive plants, animals, and plant diseases.
7. Planning flexibility in forestry in the landscape and in silvicultural systems to enhance resilience and resistance to stresses arising from climate change.

This is an exciting time in the development of Irish forests and forestry and for the many different services they provide to society. It is important that the appropriate regulatory and policy framework is put in place to facilitate this development to ensure the realisation of a shared vision for the future.



VISION

Our vision is for an Ireland with significantly greater forest cover, including a variety of different forest types matched to soil type and integrated with the landscape and adjacent habitats. As the highest expression of vegetation development in the country, native forests have the potential for the greatest variety of plant and animal life. A mosaic of open areas and forests of different types is envisaged. The open areas will include farmland, but also other habitats that are considered ecologically valuable in their non-forested state, such as species-rich grassland, heaths, and bogs. In urban and suburban areas, forests will become more commonplace and will be used primarily for non-timber purposes and providing special benefits to those living and working in built-up areas.

These forests will have a range of different canopy types and composition, and each will be managed for products and services identified in a forest management plan. The divide in public and professional perception between conifers and broadleaves will be abandoned in favour of planning and management to suit the specific site and objectives. The provision of these products and services should bring health and prosperity to forest owners and the communities in which they are located. Some forests will be non-intervention areas for conservation. The existing conifer industry will be complemented by an expanded hardwood sector to meet the demands of the domestic market, particularly if, as expected, imports become scarcer and prohibitively expensive. Forests will be managed for multiple objectives with differing priorities in different forests. There will be an increased role for native and naturalised tree species in new forests, some of which will provide wood for fuel in a world where renewable natural resources will be increasingly important for our survival. There will be many more new native forests established alongside ancient forests, and many of these will be managed primarily for conservation. All of

these forests will be actively protected from threats such as climate change and invasive species.

There will be active engagement between the forestry sector and society. This will be characterised by a clear recognition by society of the value of all the functions of sustainably managed forests and support for forest owners who actively manage their forests for the provision of high-quality products and services.

Major Recommendations

The following major recommendations are considered to be fundamental to the achievement of the vision presented above:

1. A new National Strategic Plan for Forestry

Ireland needs a new National Strategic Plan for Forestry, founded on the principles of multifunctional forestry. It should have specific goals for defined short- and medium-terms and guiding policies for the long-term. It must start with a fundamental review of the purpose of forests and how they can be managed to maximise tangible and less tangible benefits for forest owners and society.

2. Continued expansion of Ireland's forest estate

Continued investment in the expansion of Ireland's forest estate is required. This expansion should be strategic and based on spatial analysis. The mechanisms through which this expansion is facilitated should be reviewed. Particular attention should be given to the efficiency of administrative systems and the guarantee of medium- to long-term financial incentives and their smooth delivery. More specific measures are needed to favour broadleaved forest establishment and management with a view to developing a commercial hardwood forest products sector and significant expansion of native woodlands.

3. Increased delivery of multifunctional forest management

The forestry sector should aim to increase the delivery of multifunctional forest management, integrating social, environmental, and economic functions of forests on a national scale. All policy developments should incorporate the principles of multifunctional forest management. All forests should have a professionally prepared forest management plan tailored to achieve the objectives of that forest with multidisciplinary input, where appropriate.

ecological networks for species movement and colonisation of new areas in the landscape.

4. A new economic valuation system

A new economic valuation system for Irish forestry should be developed which, in addition to the timber production function, values the ecological and social functions of forests. Such a valuation system will in turn facilitate objective decision-making on the optimal management of the forest resource and the best sustainable return to the forest owner.

5. State forests to remain in public ownership

State forests should be retained in public ownership. The Minister should take an active role in regulating the sale of certain State-owned forest lands (as currently practised by Coillte) to ensure that any such sales represent the best interests of the Irish people.

6. Action on threats to Ireland's forests

Urgent action is required to combat invasive plants, animals, and plant diseases such as *Phytophthora* spp. This requires a multifaceted approach with its foundations in education and awareness amongst forestry professionals and the general public.

7. Flexibility in planning to deal with climate change

A flexible planning approach needs to be adopted to meet future climatic challenges. This must ensure that silvicultural systems are in place to strengthen resistance to expected meteorological extremes, pests and diseases, and a possible energy crisis. Policies will also need to provide



1. Introduction

Before the arrival of people, forests were the natural vegetation on much of the island of Ireland. Many thousands of years of human exploitation have created a modern landscape of fields, moorland, forests and settlements. As a result of our history, we inherited a country which had only 1 per cent forest cover at the beginning of the 20th century. One hundred years later, this proportion has risen to nearly 10 per cent. Initially, forests were planted to create a strategic resource and to create rural employment. Today, Irish people identify with forests as features in the landscape, places for outdoor recreation, sources of timber products and renewable fuel, and habitats for animals and plants. In addition, Ireland's humid oceanic climate makes some of our forest and non-forest habitats important on a European scale, including native forest communities which are unique in Europe.

New and increased pressures on our environment, including climatic change, population increase, expansion of settlements, over-exploitation of natural resources and changing social values, have contributed to the need for a fresh approach to how we value, plan and manage the Irish forest estate.

This policy review has considered the full range of forest products and services from all forest types. Although some may perceive landscape and biodiversity as romantic or nostalgic concepts, truly sustainable forest management considers these and all other resources, both tangible and intangible. The objective of this review is to point a way forward for forest owners to have profitable and sustainable forest enterprises based on ecologically-sound forests.

1.1 Context to this review

1.1.1 Forestry and heritage

What have we inherited?

The Heritage Council's policy on forestry was published in 1998¹ and reviewed in 2002². The Heritage Council has produced a number of other position papers on forestry or in which forestry is included. Since 2002, significant developments have occurred, including changes in national forest policy, the expansion of forest certification, awareness of climate change, the emergence of alternative wood products such as wood fuel, and the focus on non-timber benefits such as recreation and public health, biodiversity, carbon sequestration and protection.

The Heritage Council commissioned this review to reflect these developments and to provide a vision for the future development of forestry, with a particular emphasis on the national heritage. The Heritage Council anticipates that this review will stimulate debate and feed into discussions on national forest policy and the development of forest certification standards in Ireland.

If nature were left to its own devices, we would expect forests to cover much of the Irish landscape over tens or hundreds of years, through a process known as ecological succession. There is a small but important area of various types of native forest extant in Ireland. However, most of the forests that exist currently have not developed naturally, but are plantations established with timber production as the primary objective. These include many of our native forests, which were planted or managed for timber production over the past few centuries. Plantations can differ greatly from natural forests, not only because of their tree species, structure and the manner in which they are managed, but also because they have been established more rapidly than a forest would develop by the more gradual

¹ Heritage Council (1998)

² Hickie (2002)

process of ecological succession. The process of afforestation, as well as the way that artificial forests are managed, can affect the natural environment in a variety of ways, both positive and negative. The effects of forestry on the natural heritage can be wide-ranging and take on even more significance because the island has been almost completely deforested for many centuries. Plantations are being established currently on hitherto open, farmed landscapes with habitats which have evolved with low-intensity agriculture over a long period.

Although Irish forests are subject to the same international conventions as other European forests, they are quite different from those in other European countries. The Ministerial Conference on the Protection of Forests in Europe stated in 2007 that less than 1% of European forests are dominated by exotic species. If Russia is excluded from the assessment, the figure is around 4%. In contrast, the same report shows Irish forests are dominated by more than 85% exotics. The country with the next highest proportion of exotic trees is Denmark (about 63%), followed by Iceland and the UK, both with around 50% of their forests being of exotic species. These figures help to show how unusual Irish forests are in the European context.

Furthermore, many Irish plantations rely on single species stands. Natural forests with only one species are typical only of boreal or very dry parts of Europe, and those countries with a predominance of plantations.³

It must be recognised that, alongside agriculture, forestry is a very important land use. Ireland's forests produce a variety of wood products which contribute significantly to the economy, as well as producing a renewable source of wood for fuel. The contribution of forestry to the Irish economy will increase as the area under forest expands. It is important that the best use is made of the opportunities that the current expansion of the forest estate presents for biodiversity, soils, water resources and the landscape, while minimising any negative effects.

³ MCPFE (2007)

In 2006, roundwood production from Irish forests totalled 2.67 million cubic metres, 97% of which was harvested by Coillte. In 2006, the Irish market consumed over 1.6 million cubic metres of softwood lumber, of which just over 1 million cubic metres was produced in Ireland. Wood is the largest source of renewable energy in Ireland, accounting for 57% or 9 petajoules (PJ) of total renewable energy consumption in 2004, out of a total energy consumption of 629 PJ. Over the next decade, the contribution of wood energy could almost double.⁴

1.1.2 History of Irish forests

An understanding of the prehistory and history of Irish forests⁵ gives us a perspective with which to view the current forestry programme. Cultural preferences and the desire for increased broadleaf cover are major points of debate on Irish forest policy. Science can inform this debate. Much of what is known about past vegetation depends on identification and analysis of pollen preserved in peat or sediment. This is not a precise tool, as there is variation in the size of the area from where the pollen may be derived, and the quantity of pollen produced by individual plants. However, we know that Ireland's climate has changed over time, with repeated cooling and warming over millennia and with continental drift. Relative sea level has also changed: the limestone of the midlands was created hundreds of millions of years ago in a shallow tropical sea. In the past, between glacial maxima, the range of vegetation in the past was broader than today's native vegetation. A wide variety of trees grew in Ireland in the past that are now known only from other parts of the world, e.g. magnolia, now native to North America and Asia, Japanese umbrella pine, rhododendron, spruce, and hemlock trees.

⁴ UNECE Timber Committee (2007)

⁵ This following historical summary is based on Byrne (2005?), Kelly (1997), Lamb and Bowe (1995), McCracken (1971), McEvoy (1979), Mitchell and Ryan (2001), Neeson (1991), and Rackham (1995).

During the several glacial maxima, when global temperature was at its coldest, those areas above sea level were either extremely cold or covered with ice several kilometres thick. Different species may have survived the ice in refugia in Ireland or recolonised from elsewhere, such as southern Europe. In any event, the current warm period, which began about 10,000 years ago, has facilitated only a relatively small community of native Irish species.

Although primeval forest is often imagined as being thick and impenetrable with a closed canopy of tree tops, it was probably similar to today's European ancient forests, such as in eastern Poland and northern Sweden, with many gaps and openings in the canopy. The presence of large herbivores would have encouraged an open forest structure and allowed perpetuation of some of the dominant tree species, such as pine and oak, which have fairly light crowns and regenerate best in large gaps.

There is evidence that people have lived in Ireland for approximately 8,500 years. The arrival of Neolithic farmers nearly 6,000 years ago initiated a process of dramatic changes to the landscape, ecology, and soils. Both human activity and climatic change caused alterations in patterns of dominance among trees, while human activity appears to have caused openings in the tree canopy and an increase in open-area plants such as heather, cereals, and plantain, indicating tillage. Clearings may have regenerated, but land use over the centuries that followed has affected soils⁶ as well as vegetation. The vegetation was also affected by plants and animals introduced by people, either deliberately or accidentally, and by cultivation. Trees were used extensively for buildings, roads, wheels, and bowls, and the size of some trees is indicated by a dugout oak canoe over 15 m long and about 1½ m wide found in County Galway and dated to 4500 years ago.

⁶ e.g. Edwards and Whittington (2001).

Law texts from the 7th and 8th centuries specified who could harvest different types of forest produce and the amounts that could be taken. Bees, birch wood, firewood, and other products were all subject to regulation. Trees were important to the economy because they provided food in the form of fruit and nuts, animal fodder in the form of acorns, foliage, such as holly and ivy, and fuel as wood and charcoal. Trees were also important culturally. They were used to delineate land, and venerated trees, such as a large oak, a mound topped by a tree, or the stump of a huge tree were all acceptable landmarks, along with rocks, ditches, water, and roads. This implies that, even in the early Christian period, the landscape was not heavily wooded. It is possible that much of the forest was on less fertile or steeper terrain, although legal definitions imply that at least some forest was on land which could be cleared for agriculture. This lack of forest probably persisted for centuries, although tree planting, colonisation of abandoned fields by natural regeneration, and felling all took place.

During the Tudor period, one of the first laws enacted on forest management was that of Elizabeth I from 1558, which required enclosure for four years following coppicing and the retention of 12 taller trees per acre (30/ha) when a coppice or underwood of 24 years' growth or less was felled. The preference was for oak although elm, ash, aspen, and beech could be substituted. Planting of trees for timber, orchards and hedgerows were encouraged over the centuries. In the 18th century, exotic species were seen as status symbols, and many early plantings were of newer exotics such as sycamore, walnut, lime and horse chestnut, reflecting the importance of landscape aesthetics during this period. A comparison of the 17th-century Civil Survey with the Ordnance Survey of 200 years later shows that only about a tenth of the 17th century forests survived, although new woods had also been planted by the time of the 1830s Ordnance Survey. There was a 19th-century fashion for oak and rhododendron, and from 1840 on, Scots pine and larch were in vogue.

Landscaping was subject to changing fashions, from the straight lines of the 18th century to the 19th century Romantic landscapes emphasising wildness and liberation of nature. Recreation and cultural association were recognised as important forest functions, if only among the privileged, and woodland design from those years lingers on in the Irish landscape. For example, estates designed by followers of Capability Brown still bear his trademark beech trees.

Private afforestation for timber production in Ireland has been practised for several centuries. Lord Clanbrassil (1730-1798) was the first to propose afforestation of the more distant mountains with conifer plantations. From the mid-1700s onwards, many large landowners were encouraged to plant trees for economic return, resulting in an estimated 140,000 ha of additional woodland by 1841. However, this had little effect on a largely deforested country, which at the beginning of the 20th century had less than 1.6% forest cover. The remaining forests had been in large part over-exploited or neglected. This was exacerbated by the change from tenancy to owner-occupied farming from the late 1800s onwards. This new generation of landowners had no tradition, skills or desire to become forest managers.

Many of the forests we cherish today for their age and apparent naturalness were (re-)planted and managed for timber when broadleaf timber – such as oak – was of high value. For example, many parts of the forest at Killarney are known to have been harvested and planted⁷, and Coole Park was entirely planted from open habitat in the last 250 years⁸.

State forestry began in 1904 with the purchase of Avondale in Wicklow, which was used as a forest experimental station. Many exotic trees not previously tested under forest conditions in Ireland were planted there and remain a valuable

source of information to this day. Timber production — specifically, timber self-sufficiency — was the main objective. Forests were managed in a manner similar to arable farming, with a focus on rapid production. This meant using relatively short rotations, and straightforward, single species systems were favoured.

During the first 75 years of the 20th century, forestry in Ireland was mainly State-controlled. The progress of afforestation was initially slow and in 1951 less than 2% of Ireland was under woods and plantations. In 1948, a target of 10,000 ha per annum was set. This target was reached in the 1960s, a time of great activity in land acquisition and State afforestation. One of the main functions of forestry at this time was to provide paid employment in rural areas. However, with the advent of the Common Agricultural Policy in the early 1970s, much of the land source for State afforestation projects dried up. Despite this, by the 1980s, the afforestation programme had increased tree cover to over 7% of the country. Most of the land planted prior to the 1980s was in the uplands and on peaty or very wet sites because State afforestation was restricted to lands considered to be unsuitable for agriculture. The main commercial tree species planted during the 20th century in Irish forests came from humid western North America: Sitka spruce, Douglas fir and Lodgepole pine.

A dramatic increase in private afforestation occurred in the mid-1980s with the introduction of a series of programmes, primarily funded by the EU, to promote private sector involvement in forestry as an alternative to traditional agricultural enterprises. These programmes, which continue today with State funding, provided capital grants to largely cover the cost of establishing new forestry plantations, combined with annual premium payments to provide landowners with income from their land while awaiting their initial timber harvest. From 1980 on, EU grant-aided forestry and private or farm forestry grew to the extent that today, private planting is nine times greater than State planting, with over 10,000 farmers

⁷ Mitchell and Kelly (1998)

⁸ Dolan and Harris (1994)

involved. This period marked the most rapid expansion in Irish forests since the foundation of the State. Forest cover now accounts for 10% of Ireland's land area. The recent focus on farm forestry has resulted in a significant improvement in the quality of land being planted. The availability of more fertile land and mineral soils has made it possible to establish a more diverse range of tree species, both conifer and broadleaf. Today, 30% of all new planting is comprised of broadleaf species such as oak, ash, beech, alder and sycamore.

In 1989, Coillte, the State forestry company, was established and charged with the commercial management of 376,000 ha of State forest land⁹. Other areas of non-commercial but ecologically important forests were transferred to Dúchas, the State Heritage Service (now National Parks and Wildlife Service).

Focussing on the production of timber is not a new trend, but it is now part of a wider consideration of the role of forests. In 1998, Ireland committed to the principles of Sustainable Forest Management (SFM), which comprises three pillars: social, environmental, and economic. Sustainable management incorporates management and use of forests in a manner which allows maintenance of their ability to continue to fulfil social, economic and ecological functions into the future. Incorporation of SFM allows the type of management practised to be broadened. It also broadens the skills needed by foresters in ecological and social issues.

Two major themes emerge from this history. The first is the constancy of change and the second is the impact of people over the past many thousands of years. Contemporary natural resource management in Ireland is operating in a landscape which has been greatly and, in some cases, irrevocably affected by

⁹ Now 445,000 ha (http://www.coillte.ie/about_coillte/coillte_s_hist_ory/)

human land use over thousands of years.¹⁰ We have inherited native and plantation forests established and managed for different reasons. Our challenge now is to manage our forests for the many services increasingly recognised as vital to human well-being.

1.2 Definition of forests

This review deals with all wooded areas, irrespective of the tree species and the management objectives.

The term 'forest' may seem to be straightforward, but definitions abound. For example, the European Commission defines forest in the following way¹¹: "Forest is a land spanning more than 0.5 hectares with trees higher than 5m and a canopy cover of more than 10%, or trees able to reach these thresholds in situ... ". The Irish colloquial division between forest and woodland is in some ways artificial, and therefore the term forest will be used in this review to denote all areas examined with woody vegetation: plantations dominated by conifers or by broadleaves, areas which appear to be less affected by management, and scrub (areas of short stature forests). This report examines ways in which the roles of all these forest types might be enhanced in Ireland.

1.3 Principal Parties in Irish forestry

1.3.1 International agencies and bodies

UNCED

The United Nations held a major conference on sustainable development in 1992, during which several global agreements were signed. These included the Convention on Biological Diversity and the Framework Convention on Climate Change. In addition, declarations of principles include the Forest Principles on

¹⁰ See also Dujpouey *et al.* (2002), Edwards and Whittington (2001), and Rotherham (2007)

¹¹ EC 2006: Annex p4

sustainable forest management, Agenda 21 on environment and development, and the Rio Declaration on sustainable development.

FAO

The Food and Agriculture Organisation of the United Nations focuses on combating hunger and improving natural resource management, especially in developing countries. The European Forestry Commission is a policy and technical forum for countries to discuss and address forest issues on a regional basis.

European Union

The EU provides financial support for afforestation under the CAP Rural Development Plan for Ireland. Currently, the EU does not have a common forestry policy. The EU Forest Action Plan, adopted in 2006, focuses on improving long-term competitiveness, improving and protecting the environment, contributing to the quality of life, and fostering coordination and communication. Eighteen key actions are proposed, to be implemented jointly with the Member States during the period 2007–2011.

The EU has made several commitments which Ireland has adopted as a member state: halting the loss of biodiversity, conservation of habitats and species and sustainable forest management.

European Forest Institute

The EFI is an international organisation established by European States under an international convention that advocates and conducts forest research at the pan-European level. Ireland is not a member of the institute (as it has yet to accede to the convention) although a number of Irish organisations are associate members.

Independent certification bodies

Several certification standards have been developed to allow consumers to choose products from well-managed forests. The standard currently operating in Ireland is the Forest Stewardship Council (FSC) standard. The FSC is an international non-profit body which promotes responsible management of the world's forests through

certification and product labelling. The FSC accredits third-party organisations which are allowed to certify forestry companies to a set of standards. Coillte Teoranta, the State forestry company, has been awarded FSC certification by the accredited organisation, Woodmark.

1.3.2 National regulatory and prescribed bodies

Forest Service (Department of Agriculture, Fisheries and Food) is responsible for:

- Strategic forestry planning
- Forest inventory
- Governance of Coillte Teoranta
- Control of afforestation
- Control of felling
- Administration of forestry schemes
- Disbursement of afforestation grants and premiums
- Funding for research and development (through COFORD)
- Funding and other support to the forest industry chain
- Funding for training
- Promotion of forestry
- Forest health and protection
- Advice.

National Parks and Wildlife Service

(Department of Environment, Heritage and Local Government or DoEHLG) is responsible for nature conservation. In respect of forestry, it has the following functions:

- Management of some State-owned native forest in Statutory Nature Reserves and National Parks
- Conservation of certain State and private forests through designation as Statutory Nature Reserves, Natural Heritage Areas, Wildfowl Sanctuaries and European sites
- Protection of listed species of animals and plants in or associated with forests
- Responding as a prescribed body under Forest Consent System

National Monuments Service (DoEHLG)

The NMS is responsible for the protection of the archaeological heritage.

Afforestation can have a major impact on archaeological sites. The Sites and Monuments Record indicates archaeological sites, which must be respected by those undertaking afforestation. The NMS has published "A Code of Practice between Coillte and the Minister for the Environment and Local Government".

Local authorities

Local authorities have the following functions in respect of forestry:

- Prescribed bodies under Forest Consent System
- Ownership of certain forest sites
- Powers to create Tree Preservation Orders in respect of individual trees, groups of trees and forests
- Planning and provision of local infrastructure for the transport of timber

Prescribed bodies (under Forest Consent Scheme)

Under the Forest Consent Scheme, the Forest Service consults with prescribed bodies listed in the Planning and Development Act, 2000 for certain afforestation applications which may have impacts on wildlife, water quality, amenities and tourism. Prescribed bodies are also official bodies, with the exception of An Taisce. They comprise:

- Local authorities
- National Parks and Wildlife Service
- Regional Fisheries Boards
- An Taisce
- Fáilte Ireland.

1.3.3 State Forestry Company

Coillte Teoranta

Vested under the Forestry Act, 1988, Coillte Teoranta manages over 445,000 hectares of State forest land on a commercial basis, including ten Forest Parks. Coillte is also involved with forestry-related businesses, including panel products, wood processing, farm forestry services (including the Farm Forestry Partnership Scheme), land development, forest nurseries, and training and safety.

1.3.4 Forest industry representative bodies

Society of Irish Foresters

The representative body for the forestry profession in Ireland.

The Irish Timber Council

The representative body for sawmills in Ireland.

Irish Farmers Association (IFA)

Represents the interests of IFA members involved in forestry and provides advice and support to members.

Irish Timber Growers Association (ITGA)

Represents the interests of private timber growers and provides advice and support to members.

Irish Forest Industry Chain (IFIC)

Representative body of seventeen organisations that make up the forest industry, including forest nurseries, contractors, sawmills and forestry investment companies. IFIC's main objective is to work with the Irish government in developing and promoting forestry and to represent the interests of its members.

1.3.5 Non-government forestry organisations

There are a variety of NGOs active in forestry in Ireland, both specifically focussing on trees, or due to a more general interest. NGOs were among those who made submissions during the public consultation portion of this review (see Appendix 2).

1.3.6 Forestry research and education

COFORD (National Council for Forest Research and Development)

Responsible for State funding of forestry research. Established in 1993, COFORD's most recent €15 million programme was funded by the Irish government under the National Development Plan 2000-2006.

Third-level institutions

UCD, GMIT and WIT all have third level programmes in forestry and produce forestry graduates. They also conduct research projects on a wide range of subjects, including silviculture, forest pests and diseases, forest ecology. Many, but not all, research projects are funded by COFORD.

Teagasc (Agriculture and Food Development Authority)

State agency which conducts research in a variety of areas involving agriculture and rural development, including farm forestry. Research areas include birch, ash and sycamore improvement programmes and formative pruning of broadleaves.

EPA

The Environmental Protection Agency oversees monitoring of land use and environmental impacts in Ireland. It is also responsible for enforcing environmental legislation. The EPA publishes reports periodically on the state of the Irish environment and funds a variety of environmental research projects.

River Basin Districts

The Water Framework Directive in Ireland is being implemented on a catchment level through the River Basin Districts (RBD). Each RBD is supervising research on elements important to water quality. The Western RBD is funding a project on forest management and water quality.

1.3.7 Forestry advice

Commercial firms and consultants

Commercial firms and individuals provide forest management and consultancy services to the Irish forestry sector, principally private land owners.

Forest Service

Provides advice to growers through the Forestry Inspectorate.

Teagasc

Provides free forestry advice to farmer clients and has a role in extension

services for farmers. Eighty-five per cent of private forests established since 1980 are owned by farmers.

Other agencies providing advice include Coillte (in respect of its afforestation service to landowners), Irish Timber Growers Association (to members) and Irish Farmers Association (to members).

1.4 International obligations

Natural resource management in Ireland is subject to regulation and constraints under European Union (EU) and international agreements and directives (see Appendix 3). Forest management is also subject to international agreements such as the Helsinki Process, which adopted a resolution outlining the general principles for Sustainable Forest Management, and the Convention on Biological Diversity. Many of the international obligations have been translated into national laws in Ireland.

1.5 National laws

Among the national laws which apply to forest management in Ireland are the Forestry Act 1946, which regulates the felling of trees, the Forestry Act 1988, which governs Coillte Teoranta, and environmental impact assessment legislation which established the Forest Consent System for controlling afforestation. Other laws which apply include the Planning and Development Act 2000 and Regulations, EPA permits and regulations, and water quality legislation. In addition, the Forest Service has published a suite of guidelines required for those availing of Forest Service grants, and a Code of Best Forest Practice. A full list is presented in Appendix 3.

1.6 Changing society

Ireland has recently and is currently undergoing rapid and extensive change in demographics and socio-economic development. National-level challenges and changes relevant to forest

management considered in this review include an increasing demand for wood products, rising fuel prices, threats from invasive species, rapid expansion of towns and villages, and a trend towards urbanisation.

Many of the services provided by ecosystems to society are considered free because they are provided by nature. In many parts of the world this has led to degradation of ecosystems and their capability to provide services. In order to avoid such development in Ireland, long-term sustainability needs to be built into economic modelling and policy formulation. In this context, we need to know more about how ecosystems function and we need a detailed understanding of the connection between this and the services people enjoy.

Environmental concerns are increasingly better understood and taken into account, at least throughout industrialised countries, and this developing concern is reflected in the Millennium Ecosystem Assessment (MEA) of the United Nations. This assessment was founded on the idea that human well-being is based on the goods and services provided by the natural world. These are called ecosystem services. Four different aspects of human well-being were defined:

- security
- basic material for a good life
- health, and
- good social relations.

In the MEA, all of these were connected to services provided by nature. Some are obvious, such as provision of food and fuel, but others, including soil formation, protection of hydrological cycling, and cultural associations with elements of nature may be less obvious but are no less crucial to human well-being and survival. This review considers truly multifunctional forestry to be management which maximises the benefits from all services provided by forests, including the non-market functions.



2. Method

The review was carried out by a team of six people with diverse expertise in forest management and ecology. Team members collated and analysed information relevant to the future of forest management in Ireland. Published, 'grey' (written but unpublished), and oral sources were consulted. The team also drew on its considerable collective experience in the forestry and land use sectors. The emphasis of the knowledge search was on specific and science-based knowledge and practice. In addition, submissions were sought from all interested parties via direct contact, radio and press, relevant e-mail lists, such as the Heritage Council e-newsletter, and through publication of information on the review and the review team on a dedicated website. The main question asked of the public was, "What is your vision for forestry in Ireland for the future?" A public meeting was held on 10 November, 2007, in Galway, during which feedback was sought on a presentation of draft recommendations. This presentation was also published on the website. In total, fifty-five written submissions and a number of verbal suggestions were received over a five-month period. A list of the stakeholders who made submissions, and a summary of the themes in the submissions received are given in Appendix 2.

2.1 Approach

Forests contribute in a multitude of ways to Irish society and heritage. This review explicitly considers all the functions that forests provide to Irish society. Table 1 below presents these functions or services:

Table 1: Services provided to human well-being by forests in Ireland

<ul style="list-style-type: none">• Timber, pulp, and paper products• Fuel• Non-timber products, such as mushrooms, berries and foliage• Carbon sequestration• Protection of water<ul style="list-style-type: none">◦ Hydrological cycling• Soil formation• Protection of soil and soil ecosystem<ul style="list-style-type: none">◦ Nutrient cycling• Future use (genetics, medicines, etc.)• Biodiversity and/or conservation of specific species• Landscape connectivity (ecological networks)• Landscape aesthetics• Recreation, with benefits for:<ul style="list-style-type: none">◦ Human physical health◦ Psychological health and reduction of stress• Intrinsic value• Cultural heritage• Spiritual associations• Artistic inspiration
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3. Themes and recommendations

This section outlines the themes under consideration and highlights the related recommendations. The following themes are discussed:

- Multi-functional forestry, including biodiversity, landscape, timber, recreation, carbon sequestration, fuel, and non-timber products;
(pages 19-43)
- Forest strategy: where to plant and what types of trees;
(pages 45-62)
- Management of forests including harvesting timber and threats to our forests;
(pages 64-76)
- Forests as viable ventures for their owners, including markets and certification;
(pages 79-84)
- Legislation and structures, including governance, legislation and the licensing of foresters;
(pages 86-92)
- Training and education for professionals and the public in relation to forest management.
(pages 94-101)

3.1 Multifunctional forestry

Sustainable forest management is based on a set of Forest Principles produced following the United Nations Conference on Environment and Development in 1992. The second principle states: "Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural, and spiritual needs of present and future generations."

Multifunctional forestry involves management of the natural resource dominated by trees for several different products and services (as listed in Table 1). Management of the forest must be carefully designed to suit the various management objectives. Some functions may require more obvious management intervention than others (in places, the management prescription may be lack of intervention), but each must be specifically planned. Some benefits may relate solely to the location of the trees, such as the benefits of shelter to houses and to domestic stock in agroforestry systems.

Depending on the silvicultural system adopted, a single form of management may deliver multiple goods and services from the same forest, or parts thereof. In other cases, different management objectives may have to be met in different areas of the forest or even in separate forests.

Many of the services provided by natural systems (such as water regulation and nutrient cycling) have long been considered free. However, as our understanding of ecosystems increases and as economics becomes more enlightened, it is easier to see the crucial importance of these hitherto unvalued services¹². Neoclassical economics fails to provide a true valuation for long-term and large-scale issues, intrinsic values and the natural limits of ecosystems¹³.

¹² See, for example, Costanza *et al.* (1998).

¹³ See Nadeau (2007).

Environmental economics¹⁴ is a method designed to bring the non-market services of nature into a valuation system.

Ecosystem services can be protected through taxes and subsidies, user fees, direct payments for ecosystem services, certification schemes, and environmental damage liability. However, appropriate valuing of ecosystem services is hampered by the complexity of ecosystems versus simplicity of economic models¹⁵, as well as lack of in-depth understanding¹⁶.

Behavioural economics¹⁷ postulates that people generally do not engage in the coolly logical analysis assumed by neoclassical economists but act primarily in response to internal motivations. Examples are the desire to do 'the right thing' and a sense of fairness, social norms learned from observing others, and each person's own self-expectation and sense of involvement. Because of their dislike of loss, people are generally less likely to want to pay for a new service than they would mourn its loss. Therefore, recreation, species conservation, water quality, and other services that do not enter the market at present may be undervalued when assessed using standard economic willingness-to-pay. The full application of multifunctional forestry will go hand in hand with a new system of economic valuation of the services provided by nature.

Additional problems in natural resource management are that habits tend to persist, even when other management methods have been shown to work as well or better, and people tend to adhere to convention because it is easier. Examples include the automatic assumption that Sitka spruce (*Picea sitchensis*) should be the first choice for planting, even on land that can support broadleaf production, or

¹⁴ Based on MacKenzie (2007).

¹⁵ Opschoor (1998).

¹⁶ Norton and Noonan (2007).

¹⁷ This description of behavioural economics is based on Dawney and Shah (2005).

the assumption that clearfell is the only harvesting system that works.

3.1.1 Progress to date

There has been considerable evolution in Irish forestry over the past twenty or thirty years. Changes include increased consideration of functions beyond timber production, and inclusion of non-timber benefits in economic assessments of forestry. There has been development in recreation provision, environmental assessments have been introduced, and principles of landscape design have been incorporated into forest guidelines. Subsidy schemes have been offered and revised over time by the Forest Service, including the NeighbourWood Scheme for community recreation forests and the Native Woodland Scheme.

Recommendations on multi-functional forest management

- Forests should be managed for multiple objectives.
- Environmental and social benefits should be valued consistently with timber (on a national level) using the newly developing economic methods of valuing ecosystem services.
- Multi-resource inventories, objectives, and management plans are required for all forests.

Benefits to heritage

The adoption of these recommendations will lead to an expansion of the amount of forest in the country, in an economically sustainable manner, while also providing important public goods and services.

3.1.2 Recreation

Many people in Ireland only experience forests through recreation and appreciation of the landscape. Forests provide not only space for exercise and

play; they also offer peace and quiet, a spiritual or cultural connection, a place to appreciate one's sense of respect for the power of nature and a feeling of connection with nature, and inspiration for artists and writers. Although it may seem that the benefits of recreation are intangible, they are arguably equally important contributors to quality of life as economic gains. Furthermore, improvement of physical and mental health through recreation in nature has been shown to save on future medical costs and boost the economy by improving productivity¹⁸. Recently, there has been recognition of the importance of these functions, reflected in Forest Service developments, Coillte's recreation policy and developments such as the design and upgrading of special facilities in cooperation between Coillte and Fáilte Ireland. These developments are welcome and should be implemented in more forests near residential areas, reducing the time needed for travel by those seeking some fresh air after a long day at work.

Forests and the wider landscape provide us with places to escape from the pressures of normal life. This recreation has a psychological as well as physical benefit. Research has shown that students' test scores are improved and hospital patients recover more quickly if they can view a natural scene through a window¹⁹. Social bonds are developed through conversation and being out together, and stress is alleviated through being in a peaceful, non-built environment. These benefits are important to our quality of life, and places which contribute to the landscape and a sense of identity should be managed sensitively and with this objective in mind.

Even small groups of trees or single trees contribute to green space, although they are often considered only as an afterthought in development.

¹⁸ e.g. Tzoulas *et al.* (2007)

¹⁹ See Tarrant (1996)

Forest-based recreation activities can vary enormously, from a family walk, to picnicking, to nature-walking, to an artist deriving inspiration. Specialised activities also attract enthusiasts who use forest lands: orienteering, hillwalking, and mountain-biking are examples. Forest-based recreation is both activity-specific – going for a cycle, jog, or walk – and site-opportunistic – a pair of friends catching up during their walk, or a family out in the woods, talking, picnicking, admiring flowers, and getting some fresh air. Both types of activities need to be accommodated in forest planning.

The increasing urbanisation of Irish society means that recreational walks may be the only contact some people have with nature. This highlights the importance of urban and suburban woodlands, which are heavily used where they exist. Not surprisingly, ease of access increases the rate of usage of recreational opportunities, and these can go a long way towards providing the minimum of moderate activity which has been shown to greatly reduce rates of lifestyle-related illnesses such as heart disease and obesity.

Different types of forests are needed for recreation: local forests for short walks, suburban forests which have longer trails, and remote or wild forests for a wilderness type experience. People need open spaces locally where they can go for a comfortable walk after work, but they also need special places to visit on days off: the beautiful uplands, or large sites which allow for longer walks or cycle trails. The types of facilities and degree of interpretation at each site should suit its surroundings and purpose. Bright colours and hard materials for signage are best suited to urban areas; in other areas, the naturalness of the site should be reflected in the materials used for signs and other facilities, even if this is only a durable veneer.

Coillte, NPWS, and some local authorities and private owners allow recreational walking on their network of paths and roads. Comhairle na Tuaithe (The Countryside Council), which is a council

under the Department of Rural, Community and Gaeltacht Affairs composed of various stakeholders with a remit in recreation, such as the Forest Service, has a Countryside Recreation Strategy and a new Walks Scheme. The Forest Service has also produced a comprehensive guide to encourage owners to provide recreation where possible and in consultation with locals and other recreational users. As this guide makes clear, provision for recreation is more than a sign at the forest entrance. Although a sign or stile indicates that the user is welcome to enter, good recreation planning considers the users and their needs throughout the visit, as well as possible conflicts with other activities. Proper recreation planning should emphasise the aspects of the forest found attractive to visitors — peace and quiet, beauty, a sense of freedom, lack of traffic so children can play safely, aspects of the trees such as colours and smells — while minimising undesirable aspects such as litter. The internal landscape is another important aspect of the recreation experience, affected by the composition of the forest edge along the path, the quality of paths and benches, views beyond the trees (especially to water), and sunny glades. Recreation is a function which may be in conflict with productive functions if not planned carefully. In addition, management for recreation is closely allied with consideration of landscape and biodiversity: scenery and landscape, peace and tranquillity, relaxation, and the opportunity for exercise are the most attractive qualities. Good planning improves visitor satisfaction and encourages repeat visits.

In some sites, the forest habitat may be important. Forest composition and structure are often valued elements in the walker's experience: smells of resin or autumn leaves, colours, fungi, or noticing the first spring flowers. Access to information on landscape, wildlife, and land use heritage can help make a forest visit a varied and more fulfilling experience. Opportunities abound to inform visitors about forests and heritage, and about forest management as a

profession (see Section 3.6.4 on public engagement). However it should be noted that on some sites, the apparent wilderness should be left uninterpreted. Also, for some users, the forest simply provides the space for an activity, and some trails should just be places to walk or cycle. As in other aspects of forest planning, variety and focus on the particular objectives is the best approach.

Recreation planning involves the provision of information. Most sites should be promoted, and the information content designed with an awareness that many forest visitors may not have local knowledge. Coillte has recently provided excellent information in this area through their website:

<http://www.coillteoutdoors.ie/>. Websites, clubs, and existing community information points should be used to promote sites and kept up-to-date. At the same time, some sites should be maintained for discovery by the adventurous.

The types of recreation facilities that should be considered for certain forests include:

- Parking areas and safe places to stop in the car, and clear access routes from public roads.
- Different types of trails with consideration for all abilities: short loops, surfaced and unsurfaced, signposted or more adventurous, short to long. Different users: walkers cycling, mountain biking, and horse riding trails, with provision for potential conflict (clear signs outlining which user gives way to others).
- Map signs at entrance, designed to appear natural or forest-suited.
- Facilities to appreciate nature, such as bird hides and nature trails.
- Paths and associated furniture such as stiles and signposts that allow more serious walkers to reach the edge of forested areas easily and into higher mountainous country (and return as well).

- Interpretation and education provisions on suitable, more heavily visited sites.
- Picnic areas, play areas, and forest-specific playgrounds can also contribute to visitor enjoyment in the more developed parts of some forests.
- Public toilets may be provided to discourage uncontrolled addition of nitrogen and paper in the forest. A possible design may be the dry composting design used in the US.
- Information for the prospective visitor: up-to-date internet and local information points, and ties in with other local facilities, such as accommodation and restaurants.
- Promotion of the 'leave no trace' ethic, which Coillte has adopted, will help maintain the natural feel of the site for future visitors.

Recreation involves many different types of people and activities, and that is why recreation planning should include an open and wide-reaching consultation process. This consultation should be with local communities and potential users and will help both to make a site-specific plan which suits the local needs and to spread the word about the project to provide information for potential visitors. Development of partnerships and a sense of ownership of projects can contribute social inclusiveness and belonging, which are important elements of quality of life. Consultation is therefore not only a tool but also an end in itself. This consultation should be planned, professional, and part of a prepared recreation plan (see Section 3.6.3 on Consultation). Outreach events such as tree walks, with the opportunity to speak with walk leaders, can comprise ongoing consultation as long as the public feedback is taken on board.

Provision of recreation spaces should be funded as a public good. This is the norm in other European countries. While the new Neighbourhood Scheme will surely be welcome, support should be broadened as is currently taking place through partnership projects between Coillte and Fáilte Ireland. Beyond recreational

facilities, the mere existence of the forest is one of the main reasons a site is suitable for recreation. Trees filter out noise, provide shelter from rain, give pleasure to the eye, and encourage wildlife. Birds heard singing a forest walk are symbolic of nature itself and contribute to the walker's enjoyment. Coillte's current forest recreation programme must continue to be supported, and recreation considered as a function of private forests (see Section 3.2.2). Private landowners may have personal preferences about allowing access, but those who see themselves as custodians may be encouraged to allow access to their forests with grant-aid. This contrasts with the market-driven model, in which the financial reward is seen as the main incentive. Although market economics is indeed the basis for most of the current government's national policies, the emerging field of behavioural economics and valuing of non-product ecosystem services illuminate the benefits we gain from natural resources. Grants which allow the landowner to implement plans which reflect his or her own values will be the most successful. Also, advice and information may be of greater use than restrictions in changing attitudes among landowners.

Recommendations on recreation

Planning for forest recreation

- 1) Three types of forest recreation areas should be developed:
 - urban forests.
 - local and interpreted areas in suburban or rural forests.
 - wild areas in which interpretation and facilities (except car parking) are not suitable.
- 2) Public funding for recreation should require a recreation planning map made by a qualified practitioner. Plans should be made from the point of view of the uninformed visitor and be directed towards visitor satisfaction.
- 3) Planned facilities for specific forests should reflect the type of forest and

expected visitor. Recreational development should enhance the special nature of each site. Care should be taken to avoid detracting from the forest atmosphere or sense of being in nature through overdevelopment.

- Safe places to stop and park are essential, and alternative methods of maintaining car parks should be explored.
- 4) For certain forests that are selected for recreation, facilities should include obvious access points, route, welcome and reassurance markers, and suitably sited benches. Some sites or trails should be made accessible and attractive for those with limited mobility.
 - 5) Recreation planning should include planned and extensive consultation with users and residents (see Section 3.6.3). Events may be held to encourage liaison between the community and the owner or manager (see Section 3.6.4 on Public Engagement)
 - 6) The National Roads Authority and local authorities should consider the full forest value, including intangibles (e.g. peace and quiet) when considering a route for a new road or development.

Urban forests

- 7) 'Green' plans should be developed for urban areas in which people can enjoy 20-30 minute walks easily and in pleasant surroundings. The ideal is several medium-sized forests within easy reach of residential areas.
 - Linkage of forest sites with dedicated bicycle paths and walkways will enhance their role in the urban and suburban landscape.
- 8) New urban forests should be planned and created with extensive public consultation (see Section 3.6.3).
- 9) Local authorities should protect existing urban woodlands from

development and use them as 'core' green areas.

- Local authorities should extend their application of Tree Preservation Orders to protect urban woodlands.
- A local authority inventory of urban trees and woodlands would provide baseline information for managing and improving urban forests and trees.

10) Training for urban foresters / arboriculturalists in tree health and care should be initiated. Developers should be required to employ arboriculturalists to care for trees in new developments, and local authorities should have arboriculturalists on their staff.

Adding value to the forest recreational experience

11) Elements which add to the quality of the recreational experience and facilitate recreational use should be crucial elements in the in multi-resource management plan

12) Forest structure and accessibility are important, and the potential conflict between various functions of forest should be carefully considered on a site-by-site basis.

Design for forest recreation

13) Forest planning and maintenance should aim to preserve views from roads and major walking routes. Where attractive views are available from a walking route on a hillside, setbacks may be designed into the planting, and suitable species should be used to retain the view throughout the forestry cycle.

14) Planting in the uplands (>300 m altitude) should be carried out in a sensitive manner considering not only walkers and views but habitat conservation, landscape aesthetics, and other functions such as improving water percolation through mineral soils (see Section 3.1.9.1.2).

15) Conservation and recreation can be linked both in space and in outreach.

For example, parkland is a scarce habitat important for saproxylic invertebrates – and also enjoyable for walkers and picnickers.

Types of forest recreational use

16) Walking is by far the most common activity in Irish forests, and this should be catered for. Depending on the forest, separate cycling and horse-riding paths may be created.

17) Motorised recreation should be excluded from forests, with the exception of licenced events in suitable forests.

18) Trails should be developed within a wider context, for example, accommodation and cycling; arrival at trails by train or bus; walking trail descriptions with heritage information (see Section 3.1.4.)

The role of forest owners in forest recreation

19) Coillte should have a mandate to provide for forest recreation, with central and local government support.

20) Additional incentives may be necessary for private owners to allow recreational use of woodlands, in order to realise a financial gain.

21) Forestry agents should continue to participate in Comhairle na Tuaithe, which has developed a national recreation strategy and has made recommendations such as provision of information on countryside recreation opportunities.

Promotion of forest recreation

22) The image of Ireland as a green and natural tourist destination should be capitalised on by promoting forest trails and facilities which will encourage repeat visits.

23) A Forest Code or 'Leave No Trace' ethic among forest visitors should be further promoted.

24) Heath promotion agencies should be involved in recreation planning and modules on 'green' exercise should be added to third-level health education programmes.

25) Forest recreation should be promoted through well-designed and informative internet and information points, as well as specialist magazines, with consultation with recreation groups. Information provision should be clear and up-to-date.

26) Professional and third-level courses in outdoor recreation planning should be initiated, allowing for evolution of specialist group of professionals.

Benefits to heritage

Increased and suitable recreational access to forests will result in improved community health and quality of life, increase appreciation of natural habitats, and may strengthen the personal and cultural appreciation of forests.

3.1.3 Biodiversity

Forests, due to their complex structure and interior microclimate, have the potential to be rich habitats for a variety of plants, fungi, and animals. Although all forests in an agricultural or urban landscape can contribute to biological diversity on a regional scale, it is those habitats resembling the potential natural vegetation²⁰ which should provide the greatest variety of locally important habitats.

The important role of forests in the protection of biodiversity globally and nationally is now reflected in international conventions, national guidelines, subsidies such as FEPS, and scientific publications. Conservation and appropriate enhancement of biodiversity in the soil, water, and field, shrub, and tree layers of the forest can only be properly carried out

²⁰ See Cross (2006)

based on specific ecological knowledge such as the recommendations published by the BIOFOREST projects²¹. Further support of such surveys and recognition of their importance is essential to improving best practice.

The precautionary principle means that, in the absence of specific research, generic principles²² may guide land management to enhance biodiversity: preservation of connectivity; maintenance of the variety of habitats in the landscape; attention to the complexity of forest stands; protecting aquatic ecosystems; and application of close-to-nature silviculture.

Biodiversity is interlinked with many of the other benefits forests bring to society, including social engagement and enjoyment of forest recreation. Possible future use of species, reduction of risk with climate change, and forest health and protection are other important objectives which may be aided by halting the loss of biodiversity in Ireland and Europe.

Management of a forest for biodiversity is slightly different from that of conservation. The two objectives intersect in the case where preventing loss of a rare species means helping to halt the loss of regional biodiversity. Species that have been identified as threatened or vulnerable are protected under laws such as the Habitats Directive or under Species Action Plans. Conservation may involve improving habitat quality or removing invasive species. Protection of rare or vulnerable species is only effective where ecological knowledge informs site management.

Biodiversity contributes to most of the essential services provided by forests. Variety increases aesthetic enjoyment, reduces risk for the timber producer, and helps match tree species with soil types. Most of the recommendations of this review refer directly or indirectly to the critical importance of forests as habitats.

²¹ e.g. Iremonger *et al.* (2007); <http://www.ucc.ie/en/planforbio/>
²² Lindenmayer *et al.* (2006)

Since biodiversity is so fundamental, it is not given a separate section, but is a major theme throughout the review.

Benefits to heritage

Biodiversity is fundamental to all benefits we gain from nature. Furthermore, incorporation of biodiversity considerations into all land management will contribute to the national and EU aim of halting the loss of biodiversity by 2010.

3.1.4 Landscape

Landscape is often used to mean only the contribution of forests to the aesthetics of the landscape. But there are three important aspects of forests in the landscape:

1. The aesthetic, which includes forest location, shape, and pattern in the visual landscape. Although appearing to be an issue of design, individual interpretation of the view and sense of place tie landscape design to social psychology and culture.
2. The design of suitable habitats and ecological corridors (see section 3.2.4).
3. The use of the wider landscape for recreation.

The latter two aspects of landscape are connected to the first: landscape design. Each of these three aspects need to be addressed, and all three lend themselves to spatial analysis using Geographic Information Systems (GIS).

3.1.4.1 Landscape aesthetics

The Irish landscape is a product of centuries of land use in a particular topography and geology. Landscape is often seen as a common good, and some may assume that landscape qualities are inherent. However, part of the appreciation of the landscape lies in its interpretation as a symbol of social history and heritage. Furthermore, aesthetics are a somewhat

changeable fashion. Irish landscapes are seen as part of our national identity and used to attract tourists but, until recently, scant attention has been paid to the specifics of landscape protection.

Landscape heritage

The concept of sense of place is one of the main drivers in characterisation of landscapes. We experience a sense of place when we attribute values to a location. These include emotional connections, symbolic meaning in terms of history or nature, familiarity, or characteristics of the site which are appreciated. Sense of place is often marked by elements of the landscape, and connected with an emotion, whether it is transitory joy of beauty or a long-held attachment. It informs aesthetic enjoyment, which in turn affects recreational activity. It may be associated with a perceived suitable land use (such as with farmers who hate to see 'good land' under trees).

Today's society has inherited a sense of aesthetics which is heavily influenced by the Romantic movement. Irish landscape paintings surviving from the 18th century show "Big Houses" with broadleaf trees in even rows and in small, well-placed clumps, usually with geometric borders, reflecting the view of the ('civilised') demesne taming the ('wild') surrounding forest²³. In the 18th and 19th centuries, these estates were re-designed according to the then fashionable Romantic movement, in which composed, controlled landscapes were rejected in favour of those in which nature was seen as being liberated, creating a refreshing place for the spirit²⁴. People still appreciate the appearance of wildness, and this trend may be stronger among urban dwellers than in rural communities.

The European Landscape Convention emphasises the importance of cultural and natural heritage in the landscape. Two of the main tenets of forest landscape design

²³ Cullen (1997)

²⁴ See Andrews (1989); Pepper (1996)

are a) people dislike change, and b) local residents tend to develop a sense of place about an area. Extensive, two-way consultation (see section 3.6.3) prior to the start of operations may help address the social aspects of landscape aesthetics.

Landscape aesthetics is affected by individual interpretation as well as culture. One of the main tenets is that people don't like sudden change. Some continuous cover silvicultural systems, such as single tree selection, are well suited to maintaining landscape values while producing timber.

The Forest Service landscape guidelines are a detailed modelling of the landscape, which can be complex to apply. The general principles to make forests fit into the Irish landscape employ the aspects that onlookers appreciate, including the use of natural shapes, and natural colours and textures.

Tree species and types

Surveys have demonstrated a general preference among Irish people for broadleaves in the landscape for aesthetic reasons²⁵. A simple border of broadleaves does not increase acceptance of coniferous plantations; a natural impression is what is preferred. Forest management, with timely thinning and a mixture of textures and colours, is also important for visual appeal. Mixtures should be intimate and non-regular in the spirit of looking natural and therefore fitting to the sense of place.

Mixtures

Landscape recommendations tend to value diversity, both increasing the variety of tree types as well as species, and increasing the diversity in the forest mosaic by including gaps and uneven-aged and mixed-species stands. This is likely to promote biological diversity and potentially forest resilience in the face of

climate change (see Sections 3.1.9 and 3.3.5).

Proportion of forest cover

The opportunity to look out over forest edges and view water or open fields is considered important to many people in valuing a landscape. This indicates that there may be a maximum amount of tree cover considered aesthetically pleasing, although the actual proportion is not yet known. Existing recommendations of attractive amounts of forest cover appear to be based on subjective preference. The openness of the inherited landscape is not only related to aesthetics but also to recreation, wildlife, and sense of place.

Recommendations on landscape aesthetics

- 1) Research forest proportion cover among Irish people to determine the actual threshold beyond which the landscape is perceived to have too much forest. This should be carried out using modelled forest covers.
- 2) The Forest Service landscape guidelines should be made more user-friendly and include landscape design as part of all felling, restock/redesign, and afforestation plans.
 - Consultation on best practice standard should be incorporated in landscape plans.
- 3) For all sites over a threshold size, such as 12 ha, the landscape plan should be developed with input from a qualified landscape professional.
- 4) The Forest Service should develop a list of qualified landscape professionals.
- 5) Use GIS to model future landscapes using DEMs (digital elevation models) and 'fly-throughs' to check proposed plans. Once digitised, this can be done on all sizes of parcels and allow the threshold currently used by the Forest Service to be removed.

²⁵ e.g O'Leary *et al.* (1999), van der Sleesen (2000)

- 6) Incorporate ecological information in the GIS to permit landscape design to match ecological good practice.
- 7) Landscape design should be on a regional or national scale and incorporate the functions of ecological networks as well as the potential for development of greenways (see Section 3.1.2).

Benefits to heritage

The adoption of these recommendations will lead to a greater integration of forestry into the physical and cultural landscape and result in improved professional management of our rich landscape heritage.

3.1.4.2 Conservation and biodiversity on a landscape scale

In addition to aesthetics, the patchwork of habitats which make up a landscape are important for biodiversity and species conservation. Internationally, forest policy recommendations often focus on maintaining large areas of forest within a landscape being converted from forest to other land uses. However, the Irish landscape is already virtually deforested. This means that conservation on a landscape scale may involve stitching together patches of forest and future forest into an inter-connected network, while also maintaining the ecological value of open habitats. Many of these landscape functions can be best examined on a national and regional level, in a coherent analysis of the possible uses of various elements in the landscape. This is considered further below in Section 3.2.4.1.

3.1.5 Timber

The principle of sustained yield has underpinned forestry for some time, but sustainable forestry has been re-defined in recent years to include the economic, social and environmental pillars enshrined in the Helsinki Process. Most European countries, including Ireland, have signed

up to the Helsinki Process, which defines sustainable forest management as:

Stewardship and use of lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.

Sustainable timber production can be separated into three elements, namely:

1. Environmentally and socially sustainable methods of land management, timber harvesting, processing and transport;
2. Anticipation and fulfilment of (future) market demand; and
3. Balance of the productive function with the other forest functions, both now and in the future.

All three elements are considered in this discussion.

Timber is in demand in Ireland, where it is used for construction, furniture and furnishings, fencing and garden products, fuel, and milled boards. The total consumption of sawn timber in Ireland in 2005 was 1.81 million m³, and roundwood production is expected to increase to 4.44 million m³ by 2010. Demand is expected to increase every year. As demand outstrips availability of different types of timber products, an increasing proportion of softwood timber used in Ireland is imported from Europe and in the case of hardwoods, from West Africa and North America (see Table 2). With rising fuel prices, it makes sense to develop domestic production and reduce demand on imports travelling long distances.

Table 2: Timber imports to Ireland by country, ranked by amount (m³)²⁶

Softwoods	Hardwoods
Sweden (364,000 m ³)	Cameroon (44,507 m ³)
Finland (165,000m ³)	USA (24,151 m ³)
Baltics (147,000 m ³)	Ivory Coast
UK (103,000 m ³)	(11,156 m ³)
Germany (93,000 m ³).	

The imports of tropical timber raise issues not only with regard to fuel consumed in the transport, but also because the Convention on Biological Diversity obliges Ireland to combat international biodiversity loss. Much of the tropical timber imported into Ireland is felled illegally. Although Ireland in principle supports the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan of the EU, it is placed bottom of a table of 27 European countries ranked by implementation²⁷. Ireland does not even have public procurement policies excluding illegally felled timber. Improved production of quality hardwoods in Ireland would go a long way to preventing Ireland from contributing to loss of ecosystems and the services they provide in other parts of the world.

It is anticipated that timber supply from private forests will grow to 1.13 million m³ by 2015, while Coillte's output is expected to stabilise at 3.3 million m³ by 2010. This means that, in 2015, a quarter of national timber output may be derived from private plantations. Small diameter wood from thinnings could raise the output from the private sector to as much as 2.5 million m³ for the period 2002-2010. However, small, scattered private forests are difficult to integrate into the market. In addition, the flow of timber products to the market, as well as their size, amount, and quality, will be affected by the silvicultural systems adopted.

A considerable volume (296,000 m³ in 2006) of home-grown timber is used for fencing, 45% of which is exported, mainly to the United Kingdom. However, evolution of European regulations (2003/2/CE) on

chemicals for timber preservation will have an impact on the current use of creosote and chrome/copper/arsenic cocktail (CCA) as wood preservative by 2008. This gap may be filled by the development of alternative treatments, such as heat-treated timber, which may also provide opportunities for business development and increased use of timber in buildings and outdoor use. These treatments may also permit the use of normally non-durable softwood timbers.

Hardwood timber is of a different character, and there is little cross-over between the hardwood and softwood sectors. Varying estimates put the annual harvest of hardwood timber at between 10,000 and 50,000m³. It is unfortunate that the Forest Service does not provide a detailed measure of this. Both primary and secondary processing opportunities are needed for hardwoods. At the present time, processing standards are said by some secondary processors not to be implemented rigorously, and raw material and primary processed supply is uncertain or non-existent. Therefore, secondary processors are frequently choosing imported hardwood. There is also some evidence of theft of timber, primarily hurley ash, as well as authorised but improper extraction of hurleys in private forests. Unauthorised extraction may increase as timber and fuel becomes more in demand.

Coniferous species form the basis of the timber industry, which is still relatively young in Ireland. The infrastructure that the industry has built up has been possible due to the concentration on planting conifers. While the conifer processing industry is relatively mature in Ireland, it is now time to develop the broadleaf processing industry, which will stimulate interest in the establishment, management and processing (primary and secondary) of hardwoods. A certain volume of hardwood timber will need to become available annually in order to support this and must be preceded by a corresponding level of broadleaf planting on sites capable of producing quality hardwood. More consideration should be given to the choice of the right species for a given site,

²⁶ ITGA Yearbook (2008)

²⁷ <http://www.wwf.org.uk/barometer/barometer.asp>

taking into account soil, exposure, visual impact, and cultural considerations. Alternative species which are not currently used and the effect of climate change also need to be investigated. This should all be addressed in a national hardwood strategy which should form part of a new national forest strategy.

The successful marketing of Irish hardwood is likely to be of major importance to encouraging sustainable management of broadleaved woodlands. It is a problem for designers and architects is that the supply of Irish hardwood cannot necessarily be guaranteed as the supply chain is under-developed. In order for a demand to be created for indigenous hardwood timber, it may be necessary to guarantee that the potential demand can be satisfied. However, the marketing of sawn and processed timber from Irish broadleaved woodlands is generally poorly developed when compared with the home grown softwood industry and with imported hardwood and softwood timber.

Sourcing Irish hardwood timber can be difficult in large quantities or in regular deliveries, and this could be a discouragement of the utilisation of Irish hardwoods by timber users and architects. Several factors may be the cause of this, including lack of co-operation between disparate owners, a perception that Irish hardwoods are of poor quality and a poorly developed supply chain. This last factor may also have an important influence on the creation of a demand for Irish hardwood.

Initiatives to develop a home grown hardwood sector have been successful in other countries. For example, Coed Cymru in Wales was set up as an advocate for broadleaf woodland in Wales. It has achieved its aims through developing Welsh hardwood timber products and promoting co-operation between woodland owners, contractors and timber users. It has also successfully addressed the issue of the poorly developed Welsh hardwood supply chain through market development and the creation of two timber stores where stockpiles of sawn and processed timber can be supplied to businesses and local users. The branding of the timber as being Welsh and sustainably managed

(only FSC sources) assists in the successful marketing, in addition to the guarantee of timber quality and regular supply. These factors, coupled with increased demand for Welsh hardwood have had an influence on round hardwood timber prices in Wales which in turn has encouraged landowners to actively manage their broadleaved woodlands.

Currently, only a limited set of standardised species and mixtures are supported by grants, although more flexibility is allowed in some of the newer grant schemes. Although these Grant Premium Categories (GPCs) provide a workable mechanism to compensate landowners regarding the quality of land made available for planting, their associated standardised species and mixtures do not provide the scope to practice innovative silviculture, or maximise potential biodiversity. The result is a generation of Irish forests which do not always reflect the professional involvement of the foresters and landowners who planted them (see Section 3.5.5). A national forest estate established along such narrow parameters may be ill-equipped to respond to future market trends.

The supply of suitable land is the main limit to achieving a greater diversity of forestry tree species. However, broadleaves may be suitable for many more sites than traditionally assumed if a broader range of objectives is considered. Higher rates of grants and premiums are essential to secure such land in order to establish high-quality, mixed plantations. While financial incentives may be needed to start with, all planting for commercial purposes should ultimately be market-led. Adding value is good for the national economy.

The increased interest in the environment is likely to generate more demand among consumers for quality labels such as certification, both for domestic and imported timber. Furthermore, added-value timber products represent the best opportunities for market penetration and these can be best produced using quality

raw materials from quality sites, managed well with regard to thinning and pruning, and subject to innovative processing. The use of continuous cover silvicultural systems²⁸ producing large diameter timber with a higher percentage of heartwood has a role to play here (see Section 3.3.4.1 below).

Recommendations on timber production

Policy

- 1) A national broadleaf / hardwood policy — as robust as that for conifer forestry — should be developed immediately. This over-arching recommendation underpins the remaining recommendations on timber production, below.

Forest management for timber production

- 2) Broadleaves should be planted where the site is suitable and where they can fulfil the owner's objectives. In general, a mixture of species to suit the objectives and the site is preferred.
 - Planting design should be explored, such as the use of bands, intimate mixtures, and alternate design in mixtures or as nurse crops for broadleaves (see section 3.2.3).
- 3) First rotation broadleaves should be seen as contributing to amelioration of the site, building the resource for the future. Initial provenance selection (see Section 3.2.3.1) and regular management for stand improvement are important.
- 4) Use of a range of species and silvicultural systems should be encouraged. A strategy for selection of tree species based on potential future markets and other factors such as site suitability should be developed.

²⁸ Use of a silvicultural system whereby the forest canopy is maintained at one or more levels without clear felling.

Examples of species that have potential include: Douglas fir (*Pseudotsuga menziesii*), Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), Western red cedar (*Thuja plicata*), common alder (*Alnus glutinosa*), beech (*Fagus sylvatica*), oaks (*Quercus* spp.), sweet chestnut (*Castanea sativa*) and common ash (*Fraxinus excelsior*).

- 5) Thinning must be encouraged and supported. The growing interest in wood energy is providing new markets for thinnings, which are an alternative source of pulpwood, especially if the timber is harvested, processed and sold locally (see section 3.1.6).

Marketing and promotion

- 6) A network to promote minor species and broadleaves should be developed. This should have a remit for market development and research, branding, marketing and timber product development. Local initiatives could provide services such as small-scale technology and local management advice for owners, and provided with appropriate government support (such as Coed Cymru in Wales or the SMALLFORE project in Finland).
 - These initiatives may assist in the development of new markets and the use of alternative species, as well as better added value for timber growers.
- 7) Some form of collaboration is necessary (e.g. between owners and State/private organisations) if thinning is to be made attractive to purchasers and harvesting contractors. Marketability can be improved by combining thinning sites into larger sales packages. This approach could also be applied to wood-energy products. Recent developments in the sector such as the Clare Wood Energy Project and the funding by the Forest Service of fledgling forest owner co-operatives should continue to be encouraged and replicated.
- 8) The processing and use of home-grown (hardwood / specialist softwood)

timber should be promoted, both through direct financial inputs in the processing sector and moreover through the development of innovative marketing tools, such as woodlot co-ops and assurance standards.

- 9) Investigate establishment of a sawn-timber store to address the supply-chain problems in Irish hardwood supply.
- 10) Hardwood timber needs to be of a sufficient quality to be processed within a viable added-value chain. This is not an easy task within a first rotation resource and not only requires the very best silvicultural inputs, but also the development of new, innovative products based on the specifications that this resource is likely to provide.
- 11) Local markets and local distribution should be encouraged to circumvent problems due to increasing fuel prices.
- 12) Investigation and research is needed in new wood preservation technology, which could provide an opportunity to develop new markets for home-grown species such as Sitka spruce and other softwoods.
- 13) Areas in the Native Woodland Scheme (NWS) where native species are performing exceptionally well should be managed as demonstration areas to show how multiple functions are met on a particular site. Such sites could be focal points for professional and public information (see sections 3.6.2 and 3.6.4 on Education and Public Engagement).
- 14) There needs to be public education about certification, and the purchasing of independently certified timber should be promoted (see section 3.4.3 on Certification).
- 15) The illegally logged timber being imported into Ireland should be regulated immediately.

- The Irish government should implement FLEGT, starting with a procurement policy that excludes illegally logged timber from public projects.
 - A viable (native) hardwood section should permit long-term substitution of tropical timber with native broadleaves and non-natives, such as robinia (or black locust; *Robinia pseudoacacia*).
- 16) A promotional campaign should be developed to allow every GAA club to know the forest (and forest owner) from where hurley wood is sourced.
 - In conjunction with the GAA, the Forest Service should develop a Code of Best Practice for hurley butt harvesting.
 - 17) There should be State support for an increased knowledge base on irregular stand yield tables, non-clearfell systems among contractors, and the use of understorey (see Sections 3.3.4).

Benefits to heritage

Forests producing good quality timber will benefit heritage by providing a commercial incentive for good management and through provision of opportunities for added value downstream timber processing. Diversity within Ireland's future forestry resource will ensure that native species continue to be grown commercially, and therefore that traditional wood markets continue to be served in the future.

In general terms, species and structural diversity in plantations, designed and integrated appropriately, should contribute to biodiversity conservation objectives and aesthetic qualities.

The above recommendations may facilitate the development of new markets for products such as sawn birch (*Betula* spp.), alder, and aspen (*Populus tremula*), as well as wood for energy, extractives, bio-textiles and other products. New niche markets for wood and wood products, as

well as adding value processing to high standards, will bring associated economic and cultural gains while relieving dependency on imports in the context of increasing energy costs.

3.1.6 Fuel

The use of wood for fuel is increasingly important throughout Europe. Ireland could be in a particularly vulnerable position as energy prices rise. Ninety per cent of our energy is imported, in contrast to the EU average of 50%. A large proportion of Ireland's industrial production is critically dependent on gas and oil. The biomass energy sector has developed rapidly: analysts predict that it could redirect hundreds of millions of Euro to the economy, create over 4,000 new full-time jobs in fuel supply and meet up to 10% of our national energy needs by 2020.

The recent introduction of financial incentives has been crucial in the stimulation, development, demonstration and deployment of new bioenergy technologies. However, some of these methods are using potentially invasive species or land previously suitable for food production. These may need to be considered more carefully. In contrast, fuel from forests has been exploited for millennia.

The Forest Service grants for biomass harvesting and processing are timely and should help to stimulate the market for energy wood from forestry thinnings. Forest residues and sawmilling co-products are also already widely used for energy generation. Timber processors should be encouraged to continue to maximise the use of residues for on-site heat, power and pellet production.

As energy prices rise, the cost of firewood relative to fossil fuels will become more competitive, and thus the incentive to harvest trees for firewood — legally and illegally — could increase. Tree felling is already difficult to control through the current felling licence system and Forest Service Inspectors have to be supported

by the Gardaí (themselves hard-pressed) to enforce the legislation.

One of the main reasons for the introduction of the Forestry Act, 1946 was to control felling of trees in the years following the Second World War, in a country which by then had little more than 1% forest cover. Very little new planting had taken place in Ireland in the 19th and early 20th centuries, and trees and forests on private land continued to be exploited unsustainably. This, combined with the shortage of oil after the Second World War, meant that firewood and timber became valuable commodities. Under the 1946 Act, a felling licence is required for the felling of any tree outside an urban district or borough, subject to a number of specific exclusions for safety and horticultural reasons.

Illegal and unsustainable logging on the scale of that which occurs in Africa, South America and Asia is unlikely to occur in Ireland. However, piecemeal extraction for firewood and other purposes is a problem in a number of developed and less-developed countries. Uncontrolled extraction could re-occur in Ireland if there is an energy crisis. Urban and suburban forests may be under particular threat, not only for illegal felling but also ecological disruption through removal of portable dead wood.

Illegal piecemeal timber extraction is very difficult to control. However, there is another approach to minimising the unsustainable exploitation of the timber resource that possible future energy crises could trigger.

Of the many small, private plantations established since the expansion of forestry in the 1980s, some could function as woodlots. The woodlot is a feature of continental Europe, where wood has been used for generations for domestic heating. Landowners with such forests could manage them to supply wood for fuel on a local commercial basis. Several approaches could be used, depending on the size and nature of the plantation. If the plantation has been unmanaged, and has

poor access, it is unlikely that it will be viable for commercial timber, and trees could be cut progressively to supply firewood according to needs. In better-managed plantations, the first and second thinnings could be sold for firewood, while the final crop could be managed for harvest as commercial timber. In both these scenarios, replanting is essential, and it is required under the Forestry Act, 1946.

Firewood could be exploited by local contractors with small-scale harvesting machinery, which is suitable for such operations. This machinery comes within a price range which individual landowners could afford. For some types of forest and scrub, this harvesting of fuelwood could be combined with a revival of coppice management.

Already, a market is developing for a new generation of wood-fired boilers, some of which accept pellets, others woodchip and others both. There is also a new generation of boilers which use round logs. The first State incentive of €4000 for pellet and chip fired boilers has been disbursed and new incentives are to be launched. The process of producing wood pellets is energy-intensive and should not be encouraged with State incentives. However, a similar incentive could be applied to log boilers, with certain conditions attached. Such conditions could include proof of a regular supply of locally-produced firewood, and possibly the use of wood-fired boilers as a sole or main source of domestic heating. This would allow small forest owners to derive direct benefit from their woods through fuel self-sufficiency and would stimulate this section of the wood energy market with direct benefits to forest owners and householders and not necessarily wood energy supply companies.

Austria, Sweden and Finland currently lead the way in using wood fuel. Entrepreneurs — often groups of local farmers, agri-co-operatives and individuals — have recognised the potential of biomass and established a renewable energy package for local communities and

businesses. A one-stop-shop energy approach is offered, where the fuel supply, planting, harvesting, producing and transporting the fuel is managed. These groups are also responsible for supplying and maintaining the wood boilers. Such businesses are now up and running in Ireland and this is a welcome development.

Ireland's many small private plantations can and should serve as woodlots. In some of these plantations, the timber quality is poor because they have not been thinned or pruned and the plantation may be unviable for producing timber as a final crop. Timber quality is irrelevant to firewood, and such areas may yet have value in times of energy crises.

The sustainable supply of firewood into the future is essential, and has to be incorporated into future State forestry and renewable energy policies, along with hydro-electric power, wind power, biofuels and fossil fuels. Wood fuel may be locally produced and immediately used reducing the energy expenditure to energy gain in terms of transport.

Recommendations on wood fuel

- 1) A continued expansion of forestry is necessary not only to supply future timber markets but also firewood as a renewable energy resource.
- 2) There needs to be a strategy to protect forests from over-exploitation stimulated by rising fuel costs. Certain forests need to be protected from any exploitation.
- 3) The exploitation of wood energy from thinnings, timber products, and co-products such as sawdust should be supported, rather than from agricultural products, for reasons of food security and prevention of spread of invasives.
- 4) Ireland's many small private plantations can and should serve as woodlots. Farm enterprises may develop small lot leases. Small plots

which are not being used for commercial timber could be used to grow fast-growing native broadleaves such as birch, common alder, or hazel (*Corylus avellana*, depending on soil). These could be linked to an ongoing revival of coppice management.

- 5) The promotion of a culture of sustainable forest management is essential if timber is to be harvested in such a way that forests meet the multiple objectives of wood production, landscape, amenity, wildlife, and soil and water protection.
- 6) The provisions of the Forestry Act, 1946, relating to the prohibition on felling trees without a felling license, need to be retained when the long-awaited review of the legislation is complete (with the exception of thinnings (see Section 3.3.3) and forests currently in areas where they should not be retained (Section 3.2.4.3).
- 7) A strategy should be developed to increase the energy efficiency of wood used for fuel.
- 8) Demand for wood-fired boilers has increased significantly in the very recent past, especially in rural areas. An incentive should be offered for log boilers, but not pellet- or woodchip-fired boilers.
- 9) A verifiable source-identified system should be developed to permit consumers to choose local fuelwood.

Benefits to heritage

Harvesting firewood from local woodlots will result in less energy consumed for transport. It will also encourage the development of social aspects of forest management and forest products through community projects, contribute to revival of coppice management, and aid in the development of an environmentally-sensitive approach to fuel production.

3.1.7 Non-timber forest products

Foliage, moss, and mushrooms are all products which could be harvested from forests. However, with the exception of some foliage products, there is no current commercial market. Use of non-timber forest products can be positive, as it strengthens the personal connection with the forest as a functioning ecosystem, but some harvesting may unbalance ecological functioning or community composition. Although commercial harvesting is not common in Ireland, mosses, fungi, flowers and flower bulbs, garlic leaves, fern leaves, and dead wood have been observed being removed from forests on an *ad hoc* basis by recreational walkers. Whereas an individual person's harvest may be of limited impact, multiple or frequent harvests of a particular target organism or taxon may be damaging. The Killarney fern (*Trichomanes speciosum*) was pushed close to extinction due to overcollecting, ironically by those who found the fern attractive²⁹. More recently, in certain areas, concentrated extraction of female holly tree foliage has resulted in a reduction of their numbers. In other humid temperate regions, rare bryophytes and invertebrates have been isolated from harvested moss mats³⁰, and a similar trend is likely to apply here. The key point, as with any other harvest, is to moderate the amount collected so as to maintain a continuous supply, while maintaining a functioning ecosystem.

Recommendations on non-timber forest products

- 1) The ecological impact of each organism proposed for harvest should be researched and the precautionary principle should be followed.
- 2) If harvesting represents a potential threat to the resource or to biodiversity, guidelines based on specific ecological research should be drawn up.

²⁹ EHS (2007)

³⁰ Peck, pers. comm.

- 3) There is a need for public education about the possible impact of harvesting, particularly in recreational or conservation forests.
- 4) The 'Leave no Trace' ethic, or a forest code, should be promoted nationally.

Benefits to heritage

Non-timber forest products can encourage public interaction with nature and promote understanding of ecology. However, maintenance of biodiversity is a national priority and should take precedence.

3.1.8 Carbon³¹

There is a widespread belief that increased planting of trees leads to a net reduction in CO₂ and hence has a beneficial effect on climate change. However, increased research has shown this view to be simplistic. For example, young plantations on peat sites have been demonstrated to be net CH₄ emitters, and although there is evidence that this reduces with forest age, it is not clear how many years' growth are required to offset the release of a gas that has 21 times the greenhouse gas effect of CO₂.³² Other studies indicate that forests and forest soils may not be good carbon sinks and as global temperatures increase they may become emitters of greenhouse gases.³³ In addition, mid- and high-latitude forests may have a warming effect because the dark vegetation absorbs heat.³⁴

Current EU policy on global warming opposes the use of forests to offset emissions, arguing that the focus should be on the real problem — the reduction of emissions. In addition, calculations of the amount of carbon sequestered in Irish

forests have been of necessity based on broad assumptions and may be inaccurate. The pilot phase of the EU Emissions Trading Scheme (EU-ETS) has shown a number of areas needing improvement. These include, allocation methods, national emissions caps, and methods to assess reductions and Life Cycle Assessment (LCA) analyses³⁵ Even if the estimates were accurate, the amount estimated only represents about 22% of Ireland's reduction commitment under the Kyoto Protocol. Furthermore, the large proportion of the existing wooded estate which are planted on peats makes carbon accounting even more complex. As the climate continues to change, many of our exotic tree plantations will essentially be 'off site', leading to stress causing disease and insect problems. In this scenario, Ireland's forests could become net emitters of CO₂.³⁶ Current research indicates that Ireland should be very cautious in attempting to use its forests as a potential offset. We should move towards our goal of expanding the forest cover in Ireland, but not for reasons for carbon sequestration.

In addition, in order to assess trees as carbon sinks, a life cycle assessment from germination to decay must be carried out. However, commercial timber crops will be used as durable products and decay, albeit slowly, while products such as wood and paper have short lives and are sent to landfill, recycled, or burned — all of which release CO₂.³⁷

Climate change will also threaten our biodiversity and other services provided by forests. Wetlands are predicted to decline by approximately 40% in the next several decades, storms will increase, and species with low dispersal or no suitable habitats in proximity are threatened with extinction. These projections emphasise the importance of taking action to reduce the impact of climate change, enhancing

³¹ See Appendix 4 for a more detailed technical discussion of the background to these recommendations.

³² Maljanen *et al.* (2001)

³³ Read and Shepherd (2007)

³⁴ Bala *et al.* (2007)

³⁵ (IEA Bioenergy: ExCo: 2008:02)

³⁶ Read and Shepherd (2007)

Schlesinger and Lichter (2001)

³⁷ Moles, pers. comm.

connectivity so that species can move through the landscape, and protecting all the functions forests offer us.

Recommendations on carbon and climate change

- 1) The Heritage Council should marshal the most recent research on carbon sequestration and encourage accuracy in national policies and actions. Some of these issues are being addressed by research commissioned by The Council for Forest Research in Ireland (COFORD; see Appendix 4).
- 2) Until a full accounting method and life cycle assessments have been developed, there should be support for a continued increase in tree cover but for reasons other than carbon sequestration.
- 3) Management should enhance the other functions of forests, such as soil stability, maintenance of hydrology, and providing habitats for wildlife, which are likely to be increasingly important in a warmer, possibly drier, Ireland.
- 4) Use of a variety of tree and other species in an ecosystem to protect from future shocks. Actual assessment of the variety and the functional role of that species will require ecological expertise in site assessment and management planning.

Benefits to heritage

Increased forest cover will provide a number of benefits, but we need to take direct action to reduce emissions of fossil fuels, rather than use incomplete models to claim credit for tree planting, which is not a solution.

3.1.9 Conflicts between functions

Conflicts between objectives in a multi-functional forest management plan should be anticipated and planned for in advance. In some cases, the conflict may be of a

lesser degree than expected. For example, a case study has indicated that landscape design planning may only have a minor effect on timber-related income, while the contribution to the landscape and sense of place is enhanced. Conflicts relating to production, soils, water quality, and recreation will be discussed below.

3.1.9.1 Soils, water quality, and timber production

Soils are a natural resource which forms so slowly that it should be treated as non-renewable (see Appendix 5). This is true for both organic and mineral soils, although the characteristics and vulnerabilities of each are very different.

The forthcoming EU Soil Framework Directive emphasises that soils in Europe are still vulnerable to damage from a variety of activities. Forestry operations, if not carried out in accordance with good practice, can lead to soil compaction, erosion, and/or contamination by fuels, fertilisers and pesticides (see Appendix 5). The forest industry now operates in accordance with the Forest Service Code of Best Forest Practice and Forest Service Guidelines on Water Quality.

Research in various parts of the world has shown that forests in general terms contribute to soil formation, nutrient cycling, hydrology, and protection of water quality. These functions have not been well researched in Ireland, where forests are often dominated by plantations of exotic species and research has focussed on mitigating potential damage to aquatic systems from forestry operations. Short rotations also increase soil acidification (see Appendix 5).

Soil and water conservation are essential for sustainable land management. Fertilisers in run-off can enter water courses, and, in some cases, bad practice has caused eutrophication. Rock phosphate is by far the most commonly used fertiliser in Ireland, and it can have an extreme impact on the freshwater ecology. Some sites are fertilised from the

air, and the Forest Service is revising guidelines to reflect updated legislation. However, current best practice and guidelines have been developed in order to address many site resource problems.

Soil erosion is a natural process which can be accelerated by land use such as farming and forestry. Erosion has serious impacts: loss of soil on the site for new plants to grow (degradation of land), loss of clean water for human use, and loss of fish and shellfish biodiversity and food products through eutrophication and algal blooms.

If diversity and variety are the watchwords for biodiversity, uniformity and large-scale operations may deplete diversity. Certainly, this is reflected in the visual interpretation that precedes perception by the public and professionals. More ecological research and monitoring needs to be done in Ireland to ascertain the actual impact on ecosystems and ways in which current practice can be further improved.

The impacts of forest operations on below-ground soil interactions are also extremely important. Species composition and functional roles will affect ecosystem services. As diversity is thought to be related to ecosystem resilience and resistance to disturbance, maintaining a variety of species — from trees to soil organisms — may help protect the ecosystem in the future.

Currently, clearfelling followed by replanting is the main system used for forest management in Ireland. Whole-tree harvesting is used on a very small proportion of clearfell sites on slopes in conjunction with cable-crane extraction systems to facilitate safe working practices and economic harvesting on steep slopes or wet sites where wheeled or tracked harvesting and extraction vehicles are impractical. Whole-tree harvesting and removal of forest residues may become more common in the future as markets for biomass become more established and developed. However, this will tend to increase nutrient loss through export biomass. It is possible that various

alternative silvicultural systems, referred to in Ireland by various generic terms including 'low impact silviculture', 'irregular silviculture', 'continuous cover forestry', and 'close to nature forestry', may help alleviate the impact of current practice, including felling, on soils and water (see Section 3.3.4.1 on non-clearfell systems below).

3.1.9.1.1 Forest buffers and aquatic systems

The EU Water Framework Directive requires that no deterioration in water quality occurs as a result of adjacent land use and that 'good ecological status' is achieved by 2015. Salmon and trout and the freshwater pearl mussel (*Margaritifera margaritifera* and *M. durrovensis*) are among the species which require the highest water quality, and which have been affected by forestry operations. The pearl mussel is a protected species under the EU Habitats Directive and is dependent on salmonids for part of its life cycle. Not only is the species of direct conservation concern, but loss of the species indicates deterioration of the aquatic habitat and is thus of more general concern. Areas of particular sensitivity are those with little buffering or on acid bedrock — areas which were deemed suitable for tree planting in the last half century.

Trees alongside water courses can contribute to stream ecology through detritus and dappled shade. However, forestry operations may also pose potential threats to freshwater systems in the following ways:

- Siltation or sedimentation of stream beds and destruction of salmonid or *Margaritifera* breeding areas, particularly when highly erodible or peaty soils are involved.
- Nutrient run-off and eutrophication, whereby forestry fertiliser run-off may enter watercourses causing enrichment, algal growth and destruction of biological systems. Phosphorus is a major contributor to excessive algal growth.

- Impact on freshwater systems from incorrect use of pesticides.
- Erosion, through accelerated water transfer from the forest (via intensive drainage networks), can damage spawning areas for salmon and trout. This problem tends to relate not only to single water courses within a catchment, but more often represents a fundamental change in overall catchment hydrology and flood regimes. In addition to the erosion caused by higher peak flows, the lack of water during low flows presents an even more potent threat to salmonid and *Margaritifera* habitats.
- Acidification, on base-poor sites, whereby accelerated groundwater movement may result in acid transfer to adjacent watercourses resulting in freshwater pH levels intolerable by aquatic fauna.

The Forest Service's Forests and Water Quality Guidelines are well-developed and are a welcome contribution to the above-mentioned problems. However, in some cases, best practice may not always be followed. Adherence should be strongly encouraged, perhaps through reclassifying the guidelines as regulations.

Long-term (broadleaf) forest buffer zones have been identified as a means of counteracting the negative impacts associated with upland afforestation, clearfelling and replanting. Buffers, both wooded and herbaceous, may slow down run-off and act as filters for sediment and the nutrients bound with it. Correctly designed forest buffers may also enhance the ecology of streams through partial shading, the interception of dissolved nutrients which are later introduced to the aquatic environment in the form of coarse organic matter (leaf litter), bank stabilisation and greater structural complexity.

A recent review of literature on broadleaves on acid-sensitive soils³⁸ indicates that there appears to be very little direct information on the

³⁸ Collier and Farrell (2007)

environmental effects of planting broadleaved trees in acid-sensitive areas. Those studies that have been done were in areas where the soils, climate, and native species differ from those in Ireland. However, it is true that deeper-rooting broadleaves can help to buffer acidity, since they bring neutralizing ions to the upper portions of the soil, and their leaves can buffer acidity when decomposing and when on the tree. It is also evident that the soil horizon properties will affect rooting: high bulk density, lack of fertility and lack of oxygen through compaction or waterlogging all cause shallower rooting, even in broadleaves. Prediction and simulation of the potential natural vegetation community, i.e. the forest type which would have grown naturally, without intervention, is the best guide to the type of trees to plant and represents an application of the precautionary principle.

Broadleaf forest buffer strips could also help regulate extremes of temperature, particularly in boulder-strewn upland streams. Research in Scotland has demonstrated that this is already a significant problem for salmonid survival in some exposed streams, and temperature changes may become more acute with climate change. Coillte proposes to manage the buffer zones in its peatland forests to protect watercourses, including targeted group planting of broadleaves in the riparian zone for dappled shade, where appropriate.

Few data are available on the effectiveness of forest buffer zones³⁹ and so we lack information on how best to design and apply them to different topographical, geological and silvicultural situations. Many of Ireland's headwaters are salmonid quality, and low-impact silviculture, together with specific practices designed to minimise impacts on water systems (e.g. mounding), could reduce the scale of flood events, leading to less soil

³⁹ See Andréassian (2004) for a discussion of the influence of conventional wisdom on understanding of forests and water over two millennia.

erosion, which in turn could reduce damage to spawning beds and improve water quality

The Forests and Water Quality Guidelines provide basic guidance on the use of buffer zones to protect watercourses and maintain water quality. The guidelines provide buffer zone widths and recommendations for appropriate tree cover and establishment procedures. However, they only begin to address the design and management of the wooded buffer zone rather than providing detailed prescriptions for the integration of protective riparian forest management units within larger catchment scale commercial forests. Further research and guidance is needed to fully understand the role of forest buffer zones and their effectiveness in water quality protection.

Recommendations on protecting water quality

- 1) Long rotations should be considered wherever possible to reduce impact of nutrient export on soil acidity.
- 2) Revisions to the Forest Service *Forests and Water Guidelines* should include:
 - Recommendations on tree species selection and spacing, stocking, and preferred structural composition, as well as appropriate establishment techniques and protection.
 - Recommendations on buffer width, with particular regard to soil conditions, topography and water quality status.
 - Recommendations on holistic, catchment-based management planning and riparian forest integration, taking habitat defragmentation into account.
 - Recommendations should include densities and proximities to the river bank that are appropriate for a) salmonid rivers and b) Margaritiferid rivers, in which the relative location of the mussels in the catchment should be distinguished. This is necessary due to the sensitivity of the pearl mussel to nutrient input. Different protection measures are needed where pearl mussels are present at the site of the buffer zone, rather than in situations where the buffer zone is used as a means of improving water and river bed quality in locations away from the buffer zone.
- Thereafter, the Forest Service should set out national targets for the establishment of riparian buffers.
- 3) Revised Forest Service guidelines on use of buffers, both wooded and herbaceous, should be developed. These should be based on detailed research on buffers, and provide information on:
 - Recommended width, depending on soil, slope, and watercourse.
 - Recommendations on tree species selection, spacing / stocking / preferred structural composition and appropriate establishment techniques / protection
 - Recommendations on holistic, catchment based management planning / riparian forest integration and habitat defragmentation.
- 4) Establishment and use of buffers prior to any further operations, both harvesting and site preparation. Buffers may be only partially wooded, depending on soil type, stream order, and needs of the specific aquatic ecosystem with regards to shade and detritus.
 - Appropriate financial incentives for the effective establishment of wooded buffers must also be provided.
- 5) In areas where there is no buffer zone, case-specific guidelines need to be established as to how best this buffer can be created.
 - Other options such as reducing coupe size, slowing the rate of harvesting, and retaining some trees for later harvesting, should be considered.
- 6) Maps currently in preparation for the Water Framework Directive, such as those mapping risks of acidification, eutrophication, sedimentation, change

in flow and consideration of pollution risk from dangerous substances, should be incorporated into the proposed Landscape Strategy GIS (see Section 3.2.4).

- 7) Peats should be fertilised as infrequently as possible, and clearfells should be restricted on peat soils.
 - Phosphate-seepage areas should be constructed to reduce phosphate runoff.
 - Nitrate runoff also implies that clearfells should also be restricted in fertile soils, especially in catchments used for drinking water.
 - Where possible, drainage should be avoided and damp-loving species, such as downy birch, used.
- 8) Auditing of Best Practice by the Forest Service needs to be placed on a more formal footing with clear reporting and penalties for bad practice (see Section 3.5.5).
 - Continuing professional development and contractor training modules should be developed as needed (see 3.6.2).
- 9) Research is needed on broadleaves and possibly other upland trees, such as Scots pine, in riparian forests and acid-sensitive sites (see Section 3.6.5).

3.1.9.1.2 Soil structure and flood control

The contributions forests make to soil stabilisation and flood control have received little attention in Ireland. However, increased rainfall and increased storms predicted with global warming may make forests more important in flood control. Many headwater sections of river catchments in Ireland are forested, and almost all of these are managed conifer plantations, primarily on peat. Clearfelling on a large scale or further afforestation could have a significant effect on flood flows in the upper reaches of small catchments. A move towards low-impact silviculture, including continuous cover forestry, and smaller felling coupes, could

lead to benefits in terms of amelioration of flood flows. This in turn could lead to reduced soil erosion and related improvements in water quality.

Surface water flow is slowed down by 'roughness' created by woody debris dams in stream channels, and by the physical presence of trees, shrubs and deadwood on the floodplain. These all help to reduce flood velocities, increase out-of-bank flows and increasing water storage on the floodplain, which leads to smaller downstream flood events. However, it can also lead to backing-up of water upstream.

Strategic tree planting, as well as wetland creation, could be cost-effective methods of 'soft' engineering. Strategic locations for new forest may include buffer strips on the lower edges of fields or within the riparian zones of watercourses. Consideration of the entire catchment may be useful here, (for example, the River Basin District Management Plan approach), although it is possible that impacts of riparian vegetation are most noticeable at the sub-catchment level. Research in the UK⁴⁰ has shown that the role of forests in alleviating flooding is scale-dependent, and changes noticeable at catchment level may be less noticeable on a larger scale. Wetland habitats, such as low marshes and reed beds, also contribute to slowing run-off to waterways. Thus, alteration of those habitats for development raises the risk of downstream flooding. However, since timber production on these wet sites is slow, the major threat to the hydrology of bog is likely to be other development, such as wind farms.

Recommendations on soils and flood control

- 1) Continued training for foresters, ecologists and forest contractors on soil properties is required, with a focus on vulnerability to compaction and erosion. These should be identified and addressed in management plans.

⁴⁰ Robinson *et al.* (2003)

2) Collation of information in existing GIS databases on soil structure and texture, as well as soil type, at a fine scale (see Section 3.2.4).

3) Best Practice measures, as promoted by the Forest Service, should be followed for all for machinery operations, including concentration of travel, leaving much of the forest untouched by compaction, and audited as described above.

4) Research should be conducted on the role of forests and forest operations on flood control and stabilising soils (see Section 3.6.5).

Benefits to heritage

Increased knowledge of soil conservation should enable us to better protect aquatic ecosystems and maintain or improve water quality. It should also lead to more sustainable land management, especially in the uplands.

3.1.9.3 Timber, biodiversity, and recreation

Afforestation and harvesting can be relatively high-impact operations that sometimes raise concerns about negative effects on ecology. In a plantation, the main concerns include the impact of harvesting on non-target species and on important elements of ecosystem functioning. Issues that need to be highlighted include indirect effects of some management operations, including topsoil in water systems (as discussed above), fertilisers and pesticides, and the impact of using non-local stone for forest roads. In some cases, reliance on pesticides may be mitigated by silvicultural treatments or biological control.

Forests can be diverse habitats due to their spatial and structural complexity, but this is less likely in monoculture and single-age plantations. Important research is being undertaken on biodiversity in different types of forest, aquatic ecosystems, biological control of some

forest pests, and hen harrier ecology, to name only a few.

Multifunctional forest management for both timber and recreation can be quite straightforward, and many operations such as timely thinning can enhance the recreation experience as well as meeting timber and biodiversity objectives. Scenery and signs of biodiversity enhance the recreational experience⁴¹. There is evidence that creation of natural areas within forests is reflected in higher valuing of the site for recreation⁴². However, the recreation experience can be further improved if some accommodation is made to permit continued recreational use. Forest structure affects aesthetics⁴³ and the opportunity for some recreation activities. For example, the ideal forest for orienteering is one where the forest floor is clear at least for a route, and with diversity of physical detail (different species, densities, presence of other features such as walls and streams, footpaths etc). Brush, windrows and hollows can impede access for walking and orienteering, while the internal landscape should also be considered (clearfells are considered unattractive). In contrast to ignoring the recreational use in pursuit of the timber objective, harvesting can be used as an opportunity for education. For example, the destination of the timber or the type of harvesting used could be interpreted through signage.

Recommendations to minimise conflict between forest functions

- 1) All functions and their conflicts should be considered in the multi-resource management plan for the site.
- 2) Developments in forest ecology research, such as those which led to the robust recommendations of the BIOFOREST team, should be incorporated into policy and management on an on-going basis.

⁴¹ e.g. Horne *et al.* (2005)

⁴² Scarpa *et al.* (2000)

⁴³ Holg n *et al.* (2000)

- The specific remit of the recommendations and study should also be acknowledged. The BIOFOREST project focussed on improving biodiversity in plantations of ash and Sitka spruce.
- 3) There should be ongoing two-way consultation with forest users and specialists, such as ecologists, which will help to advance multifunctional forest management.
- 4) Stone of similar pH to the local rock should be used on new or resurfaced forest roads, which should also be designed to control excessive drainage.
- 5) The forester (see 3.5.5) and Forest Service should ensure that NPWS is consulted in connection with sensitive sites
- 6) Silvicultural treatments, such as non-clearfell systems, should be considered to retain existing habitats and minimise the need for chemicals.
- 7) Old trees may host rare invertebrates, but heavy branches and possible stem infection makes these trees a liability. Trained arboriculturalists and invertebrate ecologists should assess such trees together and develop strategies for retaining dead wood, where possible.

Benefits to heritage

Resolution of conflicts between functions at the planning stage will improve management of forests in Ireland for all users.



3.2 Forest strategy

The authors of this review support the national objective to increase the area under forest in Ireland. However, it is important that new forests are of the right species, suitably located in the landscape and designed to fulfil the various functions of the specific site in the long term, particularly biodiversity, aesthetics, and production of quality timber. The expansion of the area under forest presents an opportunity to devise and apply a forestry strategy which pinpoints suitable locations for initial afforestation and corridors linking them.

3.2.1 Progress to date

Great advances have been made in collection, collation, and distribution of ecological and environmental data that can improve proper siting of new forests. A GIS database (Indicative Forest Strategy) has been developed by the Forest Service, making use of several different existing data layers, including soils and important vulnerabilities. This is available to registered users of the online Forest Industry Mapping System (FIMS). In addition, aerial photographs are available for viewing on many Local Authority websites. NPWS has collected data of several habitat types, including native woodlands, and the National Biodiversity Data Centre has been set up to collate existing biological and ecological data.

The Forest Service has set up a Forest Consent System and a decision process to determine the need for Environmental Impact Assessment. The Native Woodland Scheme and Biodiversity guidelines help protect forest-dependent species, and the creation of a Forest Ecologist staff position within the Forest Service ensures in-house expertise. Several incentive schemes incorporate conservation of open space and/or ecological assessments, while Coillte, as a major land owner, has initiated ecological surveys of all of its forests. Species in need of special protection have been the subject of Species Action Plans to inform Coillte

staff, and Coillte has also developed three EU LIFE-funded projects to restore habitats on State forest land.

3.2.2 Incentives to plant trees

The system of grant schemes operated by the Forest Service is the main mechanism used to encourage tree planting. In general terms, the main focus of these grants has been afforestation with an ultimate goal of timber production. There has been a somewhat single-minded focus on the area afforested each year and this appears to be the most important performance indicator by which the industry is judged. More recently, however, the focus has widened with the addition or expansion of some grants.

Forest Service guidelines, such as those on biodiversity, apply to land owners who avail of the grants. This means that forest owners who do not avail of grants are not obliged to follow national guidelines. There are legal obligations on owners associated with the control of tree felling and the protection of certain wildlife species. However, outside of these, those forest owners who do not sign up to be assessed for SFM certification and who do not have land designated for conservation are, in principle, free to do as they wish with their trees.

The Afforestation Scheme assumes an objective of timber production and generally assumes harvesting will be by clearfell. The current target was set in the 1996 policy, *Growing for the Future*, at 20,000 ha/ year. Recent figures achieved are as follows:

Table 3: Planting areas by year

Year	Area Planted (ha.)	Broadleaf %	Avg. Size (ha.)
2002	15,054	17	9.7
2003	9,097	23	8.9
2004	9,739	29	8.6
2005	10,096	30	8.2
2006	8,036	31	7.9

The rate of planting has fallen, despite recent increases in grants and premiums.

Planting of broadleaves and conifers other than Sitka spruce is encouraged through higher premiums. However, training, familiarity, confidence in performance and availability of planting stock may all determine whether a forester will recommend planting species other than Sitka spruce. The falling rate of annual planting is of major concern within the forest industry, particularly for nurseries and private forestry companies, since their businesses are dependent on this activity. Blame is placed on a number of factors such as high land values, the drop in value of land when it is forested, rates of subsidies for other land uses and environmental constraints that can 'sterilize' areas which are otherwise plantable.

There are two other schemes which contribute to forest expansion. The first is the Native Woodland Scheme, which is discussed below (see Section 3.2.5 on expanding native woodlands). The second is the Forest Environmental Protection Scheme (FEPS), which aims to encourage the planting of high nature value forestry on REPS farms. FEPS is based on the Afforestation Scheme but is allowable within REPS with additional environmental measures. This scheme has the support of the industry and represents an attempt to provide a balance between public benefit and commercial forestry. A second module of FEPS (the "Enhancement" module) is planned⁴⁴ and will promote intervention in existing, primarily coniferous, forestry to convert these to high nature value forests.

Other schemes operated by the Forest Service are the Woodland Improvement Scheme, which promotes rejuvenation of old forest for timber production through operations such as pruning, shaping and thinning. This scheme is suspended at the time of writing. Grants are also available for forest roads and for reconstitution following failures caused by natural catastrophes.

The NeighbourWood Scheme supports the provision of facilities for recreation. It is a scheme designed for developing community forests where there is currently or potentially a high level of public usage. The Forest Service Recreation Guidelines referred to above provide a resource for forest owners considering this use.

There is a widely held view within the commercial forestry sector that it is over-regulated and that the level of constraint imposed by outside agencies on private forests threaten to render them uneconomic. Furthermore, there is a widespread perception within the forestry sector that "environmental" forests are uneconomic and commercial forests are of limited ecological value. It is known from elsewhere in Europe, and in some cases in Ireland, that this is not necessarily the case. It is in the national interest to identify the steps which can be taken to ensure that Ireland's forests will be both ecologically and economically viable and therefore truly sustainable. National forest policy must address how this can be achieved, otherwise the sector faces a future of over-regulated "commercial" forests and over-subsidised "environmental" forests. The Forest Environment Protection Scheme (FEPS) is a step in the right direction in terms of establishing a balance between commercial and ecological goals. There are many ways in which this balance can be struck and Section 3.3.4.1 below argues that continuous cover silvicultural systems can also deliver this balance where site conditions are suitable. A new FEPS "enhancement" module is planned, whereby existing forests will have their "environmental value" enhanced through a series of measures. This is a good opportunity to introduce diversity into some of the older private forests planted before the introduction of the various environmental guidelines and codes. It is important that, while the administrative workings of the module will need to be agreed between the Forest Service and the industry, this new enhancement module receives guidance from those with expertise in this area, such as forest

⁴⁴ at the time of writing.

ecologists and close-to-nature silviculturalists.

Recommendations on forestry incentives

- 1) The planned enhancement module of FEPS should have significant input from forest ecologists and close-to-nature silviculturalists with experience in this area.
- 2) The enhancement module of the Forest Environment Protection Scheme (promoting intervention in existing, primarily coniferous, forestry to convert these to high nature value forests) needs to be merged with the extended Woodland Improvement Scheme (promoting the pruning, shaping and thinning of established forests).
- 3) Although evolution of incentive schemes to better suit multiple functions of forests is essential as forestry changes, it is preferable that schemes are not suspended while being revised (see Section 3.5.2).

Benefits to heritage

A greater emphasis on the ecological aspects of existing afforestation incentives, alongside awareness-raising among professionals, will assist in the integration of the many different functions of forests.

3.2.3 Selection of tree species

Currently, The Forest Service lists thirty-three 'acceptable tree species' which are permitted in grant-aided planting. Nineteen of these are conifers, while fourteen are broadleaves. The 14 broadleaves include birch and rowan, which are categorised as 'additional broadleaves' (Adb) and may only comprise up to 5% of the overall mixture within the Afforestation Scheme. However, the NWS allows for the planting of further (unlisted) native species, and at greater percentages than under the Afforestation Scheme. The FEPS also allows native species, although the focus

is on the same acceptable species as those listed above.

These species are often planted in monocultures to facilitate planning with regards to rate of growth and future management. However, mixtures can be of great use as nurses and to provide side shelter, and mixtures better reflect forest composition when the result of natural processes. Improved knowledge of mixtures and their application, as well as nurses and a variety of silvicultural systems including single tree selection systems, will result in better planning. The species planted initially are not necessarily those which will comprise the forest at a later stage. Natural factors such as the height range, tolerance of shade and competition, and growth rates and management, alter the species composition as the forest develops. The forest is much more than the canopy alone. Some species useful for firewood, such as hazel, are actually shade-producing understorey species and so will either dominate a low-stature forest or comprise an understorey in a mixed-stature forest.

The species planted should suit the objectives for which the forest is being managed. Broadleaves should be planted for commercial reasons, as well as for landscape, water protection, recreation, and conservation. The owner's preferences and objectives should also influence the species planted. Focussing on a specific proportion of broadleaf planting may not achieve the hoped-for effects. For example, far too much common alder is being planted currently, and some is planted off-site; such stands are at high risk if an alder disease emerges here as it has in Britain, or if the wet sites with moving groundwater preferred by alder dry out as a result of climate change. Instead, matching the species mixture to the objective will result in a varied forest estate, depending on site, soils, and objectives.

The species planted should also not impinge on any of the objectives of the forest or of adjoining areas. For example,

non-native trees such as sycamore, beech, lodgepole pine (*Pinus contorta*), grand fir (*Abies grandis*), and western hemlock (*Tsuga heterophylla*) regenerate freely in Irish forests and may not be suitable for planting in some areas due to the threat they may pose to the integrity of a nearby native forest.

At the time of writing, there are seven Grant Premium Categories (GPCs) relating to various mixtures of accepted tree species. The GPCs operate on a scale of increased grant assistance related to the individual site's ability to support a wider range of species. These mixtures are standardised, and acceptable mixtures are referred to in the Forestry Schemes Manual. However, there is a wider range of tree species suitable to both Irish growing conditions and potential timber markets than is currently recognised. Some native species can root deeply despite high winter water tables. Production should be broadened, and processing developed on a local or regional basis. For example, aspen and cherry are native species with high value timber. Another example is downy birch, a pioneer which is tolerant of a range of soils. Downy birch, which can produce furniture-grade timber in 40 years, naturally forms almost pure stands, so mimicking this in pure plantations is appropriate. Silver birch is a similar species which grows on sites with slightly higher pH and water movement. Alder, yew (*Taxus baccata*), Scots pine, hazel, willow (*Salix* spp.) and spindle (*Euonymus europaeus*) are other species which have been used for attractive timber products in the past. The re-development of these markets may stimulate a re-awakening of heritage skills. In addition to the natives listed above, non-native species could be grown in greater amounts to meet demand. One example is European larch, traditionally used for boat-building, but which is currently imported. Many conifer species may thrive in Ireland even with future climate change. Diversification of the tree species planted should consider the objectives fulfilled by the various elements of the mixture. If timber is an objective, production of quality timber and

alleviating the demand for tropical timber should be considered, but biodiversity, recreation, landscape, and other functions should also be taken into account.

3.2.3.1 Mixtures

There are many silvicultural reasons for planting mixtures of tree species, in addition to biodiversity and visual beauty. Currently, only some particular mixtures are accepted by the Forest Service, but more effective mixtures may be possible. For example, the current practice of using only Scots pine or larch as a nurse crop to help oak become established, planted in alternate lines, is often ineffective. Furthermore, if the nurse is left too long, it may overtop and stunt the growth of the oak. Instead of designated mixtures, it should be possible to plant any mixture of broadleaves; the responsibility should be placed on the forester to justify the afforestation mix (see Section 3.5.5: Licencing foresters). For example, much of the historical literature states that ash should not be planted as a pure crop and that it requires shelter. This species could possibly perform very well if it was planted in a mixture. Other types of mixtures should be considered e.g. the use of bands rather than alternate lines, which may provide a more robust system. Other broadleaves such as alder and birch may be good nurses, but research is required to examine these mixtures.

As well as using lines and bands of different species, intimate mixtures and the use of underplanting and understoreys should be permitted. An understory species can help prevent the development of small shoots, or epicormics, from a larger bole after thinning. Understorey species should also be planted to provide food and shelter to forest fauna or to benefit the internal landscape of the forest for recreation. The use of natural regeneration for broadleaves should be permitted, and it should be taken into account that nature may not conform to our time scale (currently only 7 years for the NWS) or a specific stocking density.

Research is needed on many of these mixtures prior to their promotion. The forest industry needs to increase its knowledge of mixtures, taking on board international experience and historical literature.

Recommendations on selection of tree species

- 1) A national broadleaf strategy should be developed as part of the GIS-based Landscape Strategy (see Section 3.2.4).
- 2) Mechanisms must be developed to increase the proportion of broadleaves for timber, including planting on better land. It is important that broadleaves are not just planted for the sake of achieving a certain proportion of the total planting programme. This can be assisted by:
 - Reviewing ecologically suitable land with a view of leaving unsuitable land or valuable habitats unplanted (Section 3.2.4.2).
 - Reviewing the assumption of a timber production function on all sites.
 - Ensuring management is suitably prescribed and implemented to achieve the objective(s).
 - Expanding the native woodland establishment programme (see Section 3.2.5)
- 3) More consideration should be given to choosing the right species for a given site, taking into account factors such as soil, relative growth rates, exposure, visual impact, management objectives, and cultural considerations. This may mean:
 - An expansion of the list of permitted species;
 - Exclusion of certain invasive tree species; and
 - Incorporation of new silvicultural practices or systems intended to improve the quality of broadleaves grown in Ireland and that better serve existing timber markets.
- 4) There should be government support for the development of new markets and the potential for expansion of niche timber markets, such as small-diameter wood, through silvicultural methods (e.g. coppice).
- 5) The Native Woodland Scheme is an ideal catalyst to promote the value of our native species (see Section 3.1.5 on timber).
 - In addition, a wider array of non-native species, providing they are not invasive, should be considered on suitable sites. Examples are Douglas fir and larch, as well as some of the North American oaks.
- 6) We need to investigate other species for forestry and model the effect that climate change may have on species performance and site suitability.
- 7) The forest industry needs to increase its knowledge of using pioneer crops, mixtures, nurse species and techniques such as underplanting, taking on board international experience, historical literature and new research.

Benefits to heritage

Species mixtures, including those not previously considered for timber, will add to the diversity of Ireland's forest habitats and will be an insurance against future shocks such as climate change and new or emergent pests and diseases.

3.2.4 Landscape strategy for forests

New forests have the capacity not only to provide timber and fuel but also to contribute to the visual appeal of the landscape, provide quiet corridors for recreation and increase forest-related biodiversity. These latter roles can be enhanced by well-chosen siting of new forests within the mosaic of soils and habitats we have inherited. Strategic siting of new forests is possible with GIS and promotion to landowners.

Currently, the Forest Service has a decision support system to indicate if an application for afforestation should be subject to an Environmental Impact Assessment (EIA). The cost of environmental assessment is placed on individual owners and results in a piecemeal approach to forest expansion. This situation should be remedied through the development of a landscape-scale forest strategy, using GIS. This approach would highlight the mosaic of habitats and permit strategic siting of new forests for different forest functions.

Landscape modelling

Many landscape functions can be best analysed on a national and regional level, in a coherent analysis of the possible uses of various elements in the landscape. This analysis is possible with GIS, together with comprehensive, fine resolution, accurate data sets.

The ongoing collection of ecological data on habitats and habitat quality should be incorporated into a national GIS that can be used as a basis for strategic planning of multifunctional forests in the landscape. GIS is a very useful tool, but it is only as good or as precise as the data incorporated. Continued refinement and improvement of data and models is crucial. Furthermore, expert practitioners, including academics, should be consulted directly about creation of new data layers, possibly through a multi-agency and multi-stakeholder working group.

Assumptions in the modelling should be regularly reviewed. For example, is a site not suitable for timber production one that would be enhanced with new native forest? It is also important to include predictions on future hydrology and habitats, predicting the changes expected with changing climate.

GIS will underpin the proposed Landscape Strategy and permit use of multiple types of data to identify the areas suitable for native forests, development or restoration as parkland, retention as open habitats, etc. These may fulfil ecological functions (network) as well as aesthetic or productive ones.

The recently completed National Forest Inventory (NFI) by the Forest Service is a

welcome step towards the establishment of comprehensive, permanent and up-to-date information on the national forest estate. The national Indicative Forest Strategy (IFS), a GIS-based database which is currently available through the Forest Industry Mapping System (FIMS), is another welcome development. A forest landscape strategy is only of use if it is actually used as a strategy. It is a strategy for where forests and corridors of different types should and should not be located. This will involve promotion and working with landowners, and advisors such as REPS planners. It may also involve greater use of the derogation permitting reversion of unsuitable forests to the original habitat types. The data used must be of a sufficiently fine scale to allow virtual analysis as well as an enhancing implementation of the Strategic Environmental Assessment (SEA) requirement for forestry programmes and plans.

The EU Strategic Environmental Assessment (SEA) Directive requires assessment of all formal plans and programmes (but not policies) prepared for forestry⁴⁵. The objective is to predict and mitigate environmental impacts of the plans and programmes, and their alternatives. SEA and EIA should be used to mitigate any negative consequences, rather than solely assess them. The advantage of SEA versus project-level EIAs is the broader view and its potential to examine effects that may arise indirectly, or because of multiple projects (additive or multiplier effects). SEA also makes the entire procedure of creation of the plan or programme transparent to the public and stakeholders. SEA should assist in siting forestry in the right place; it should also indicate the optimum type of forest and area, matching other environmental aspects such as conservation values, geology, soils and development.

⁴⁵ Scott, pers. comm.; Scott and Marsden (2003).

The broad approach in a SEA should be to collect information; the environmental issues against which the plan or programme are to be assessed should be broad and include biodiversity and habitats, and soil and water quality. These must be taken into account but, ultimately, may not be the determining factors. The reasons for the ultimate choice of a specific programme may be social or economic. These reasons must be clearly laid out in the report.

A SEA report should address the current status of relevant parts of the environment and the likely impact of the proposed plan or programme. Consultation is also required with the public, environmental agencies and experts on the proposed plan or programme. The resulting responses must be included with environmental and ecological information.

The topics to be addressed in a SEA include:

- Biodiversity;
- Plants and animals;
- Soil and water;
- Air quality and climate;
- Human population and health;
- Material assets;
- Cultural heritage;
- Landscape;
- The interrelationships between the above; and
- Technical or knowledge gaps.

In addition, the SEA should describe the impacts of the programme or project on each of these factors and give a statement of reasons for choice of the alternative selected. At the time of project adoption, a statement is required describing how constraints and alternatives were taken into account.

Some SEAs which have been carried out in Ireland to date have been similar to EIAs, in which well-developed plans are examined for their environmental impact. However, SEA can instead be 'objectives-driven'⁴⁶, offering the opportunity to explore environmental projects at a much earlier stage, permitting a wider examination of options and solutions.

⁴⁶ Desmond (2007)

As well as being a useful tool for planning a SEA, the Landscape Strategy GIS should become a multi-agency, multi-resource database.

3.2.4.1 Connectivity of habitats

Strategic planning of new forests can assist in reducing fragmentation of habitats, which is a major threat to the maintenance of biodiversity. Wildlife species need to be able to move through the landscape from one habitat to another, and this will increase in importance as the climate changes and species may need to move to find suitable habitat.

Fragmentation refers to habitat loss, degradation or isolation. There are five methods⁴⁷

by which people affect landscape patterns:

- perforation of a dominant habitat,
- dissection,
- fragmentation,
- shrinkage, and
- attrition.

The Irish landscape is already fragmented but is undergoing dissection (cutting of remnant pieces of a habitat), shrinkage, and, particularly, attrition (loss of patches, often the lowest in productivity in a matrix of utilised land). Landscape analysis for planting of new forests and corridors should be focussed on how the landscape elements function together, rather than solely on the pattern of these elements.

Some species of forest animals and plants can move easily from one small patch of forest to another, but others cannot easily colonise new areas. Even a relatively temporary area such as a clearfell can be an obstacle, although snags, shrubs and live trees retained can improve accessibility of a clearfell for some species. There are species which can only survive in the interior shade and humidity of a fairly large area of forest where they

⁴⁷ Forman (1995 in Lindenmayer and Fisher 2006)

can live far from the sunlit edge. However, few if any of these species are thought to remain in Ireland. Many species, including fungi and invertebrates, remain unstudied, and it is possible that some forest specialists remain. At the same time, there are indications that forest species here may be able to survive in smaller patches of forest than they can in drier or sunnier parts of the world. Although ecologists have long been concerned with habitat fragmentation, the conditions which make a certain area suitable are expected to evolve along with climatic change, which could force some species to migrate. Those which cannot migrate to a suitable new habitat could become extinct locally. Therefore, forest management planning should focus on ease of mobility of various species in the landscape.

Movement through the landscape can be assisted with the use of corridors or stepping stones. Some species, such as many bats, commute from their roosts to hunt, and will benefit from such corridors. Corridors may also be used as extensions of a habitat, thereby increasing its effective area.

Areas important as corridors include linear habitats such as hedgerows and rivers. These can be linked with larger core areas of habitat, which may be forest, rivers, lakes or uplands. These broad habitat types are considered to be more valuable if they have been less intensively managed, such as grassland that has had little fertiliser or has not been re-seeded. Other areas, such as those which have been more intensively managed, could be selected for creation as corridors, such as planting with patches of native forest.

There has also been fragmentation of micro-habitats within forests. This is especially harmful to species associated with older trees, forest interiors, or large-diameter dead wood. For example, heavy-branched trees can be important for saproxylic invertebrates, including rare species; forest biodiversity may be enhanced by addition of slight different habitat such as parkland. The complexity of the habitat, its size and proportion are

also important, along with knowledge about the targeted species.

Riparian woodlands can be excellent corridors, and they could simultaneously protect water quality (see Section 3.1.9.1.1). The First Edition Ordnance Survey maps show some areas where lines of trees appear to border rivers. These could be old forest, and restoration or re-establishment of such forest may help to re-establish a valuable habitat.

Recommendations on where forests should be planted

Landscape Strategy

- 1) A national-level Landscape Strategy should be developed, to apply to forestry and all other land uses. It should be a cooperative initiative, involving all the responsible agencies, and coordinated by the Department of Environment, Heritage and Local Government.
- 2) The Landscape Strategy should be an expansion of the IFS and include all available fine-resolution data layers, including the inventory of native forests. Existing data should be subject to ongoing refinement, correction, and improvement. The data should be available to all forestry and ecology professionals.
- 3) Ultimately, the strategy needs to include a national habitat map on a fine scale, similar to the JNCC Phase 1 in the UK. This can only be done when ongoing and planned NPWS surveys of habitat types have been completed and incorporated into the Landscape Strategy GIS. County biodiversity surveys and action plans should further be incorporated, and additional surveys should be supported on an ongoing basis.
- 4) The Landscape Strategy should indicate where afforestation of different types would assist in timber production, wood fuel production, conservation, protection of waterways,

- connectivity of habitats, and aesthetics.
- The strategy will also identify core forest areas that can be amalgamated, expanded, or connected using corridors.
 - The strategic analysis should be followed up by encouragement of the right type of forest in the suitable locations, such as through higher premiums and promotion to owners of the relevant sites.
- 5) The Landscape Strategy should be used to enhance the connectivity of forests in the landscape as follows:
- This network of corridors and stepping stones, once identified, should be actively promoted by the use of incentives and communication with landowners.
 - Rivers may be part of this network, but not as densely planted lines. Parts of rivers should remain open; upland streams may always be open.
 - Strategic design of corridors may assist with visual integration of existing forests into the landscape.
 - These corridors may be linked to access and routes: people like walking along a tree line with a view on one side.
- 6) Existing forests should be actively protected:
- Local authorities should protect existing forests from development (see Section 3.1.2).
- 7) The Forest Service should actively protect existing forests by making submissions to development plans and refusing felling licences, where necessary.
- 8) An economic model should be created to include the benefits forests provide to society in their valuation⁴⁸ and thereby preventing roads, landfills and other non-forest uses from breaking up valuable forests.

- 9) The threshold for landscape and ecological impact assessment should be considered on a catchment or landscape scale. This would be addressed by SEAs for programmes and projects.
- SEAs should be 'objectives-driven' and carried out by teams of experts with the specific skills to address the topics required.⁴⁹

Benefits to heritage

Strategic and thorough environmental assessments and strategies for afforestation will help make the expansion of Irish forests ecologically sound. Creation of ecological networks may maintain and enhance national biodiversity, especially in the context of climate change, and could also contribute to the aesthetic beauty of the landscape.

3.2.4.2 Resolution of conflict between afforestation and marginal habitats

Increased forest cover in Ireland, if appropriately designed and managed, will generally benefit biodiversity as well as rectify the historical loss of forest cover. However, expansion of forest should only be permitted in those non-forest habitats which are not now of nature conservation value. Currently, trees can be planted in sites which are undesignated but may be valuable habitats, such as wet grassland, other unimproved grassland, and heathlands. The most threatened habitats include areas which are biodiverse, but it should be noted that some ecosystems now fairly common in Ireland, such as moist habitats, are predicted to be under strain to the point of disappearance with the future change in the climate. On paper, it appears that the Forest Consent System operated by the Forest Service could prevent valuable habitats from being planted, but in practice this mechanism appears to be inadequate.

⁴⁸ e.g. Goldman *et al.* (2007)

⁴⁹ See Scott and Marsden (2003)

Because the removal of forest over the past several millennia was not random, specific communities of organisms have been affected or lost. There are no untouched or pristine areas in Ireland; we have inherited a greatly modified landscape but one which supports much of ecological value. Because of the long tradition of agriculture in Ireland, most habitats that were easier to bring into modern production have been re-seeded or fertilised. The areas that are not amenable to such improvement, and which consequently may have more typical natural plant and animal communities, are often earmarked for afforestation. The reasons for this include current financial incentives for initial afforestation combined with a lack of profitability of marginal farmland. Additional reasons are the degree of ecological knowledge among foresters and REPS planners, and pressure created by the nation focus on forest area. It also does not help that planting levels appear to be the principal performance indicator by which forestry is judged.

The Forest Service conducts a pre-approval screening process under the Forest Consent System, introduced in 2001. Under this system, a report form which contains an environmental checklist is prepared by an approved forester. The checklist includes presence/absence of designated habitats, presence/absence of a REPS plan habitat and a comment box to specify 'other environmental considerations'. There is no provision in the form to describe the habitat type proposed for planting. In addition, the level of classification used in the current habitat classification, published by the Heritage Council in 2000, is general and may obscure some types of habitats of greater conservation interest by virtue of having to include them with other similar habitats. In this system, it is up to the individual Inspector to determine whether the site should be investigated further. Non-designated sites of ecological interest could 'slip through the net'.

Habitats are classified according to vegetation communities, but the

distribution of animal species may not follow the same boundaries as the vegetation. General principles and research from other countries often must be used, but it should be noted that at least some Irish populations of species behave differently from their cousins in other countries, creating uncertainty when using species information for other countries.

A prohibition on blanket afforestation of a habitat does not mean such areas may not be suitable for creation of stepping stones in the ecological network. Many sites of interest are mosaics of different soil types. For example, without grazing and other human use, small patches of forest would probably persist on the rocky knolls within blanket bog (or, sometimes, raised bog) landscapes. Restoration of these small sites to native forest does not conflict with preservation of the surrounding blanket bog.

Afforestation of non-wooded habitats of conservation interest should not be permitted unless it can be shown that environmental benefits outweigh the losses, and any afforestation permitted in these areas should only be of native species. The same conclusion applies to other development, including roads and recreational development, since some animal species require seclusion.

The conservation of the species known or expected to be associated with each habitat could contribute to public engagement on biodiversity and ecology. Some birds may be good flagship species for educating the public and pinpointing ways in which forestry can blend with, rather than cover, the landscape.

Recommendations for the protection of undesignated habitats

- 1) The precautionary principle should be applied: sites should not be approved for planting unless the Inspector is sure that the current habitat lacks any special ecological interest.

- A simple in-field key should be developed to assist the licensed forester (see Section 3.5.5) with determine whether the site is of minimal ecological interest as is.
 - The key will help pinpoint the consultation required. The same list can be used later by the Forest Service in auditing this file.
 - Foresters and Forest Service inspectors should receive additional training in ecology of non-wooded habitats and the use of the key, once it is developed.
 - In the event that the Inspector cannot be confident that the ecological value of the site will benefit from afforestation, a plant ecologist should examine the site.
- 2) No existing non-forest Annex I habitats should be converted to forest land use, whether or not that site has been designated.
- 3) In the absence of the key and training described above, and a comprehensive, fine-scale GIS-based landscape strategy, all sites should be passed to NPWS and disapproval of afforestation assumed until news to the contrary is received. As this is integral to the national and EU goal of halting the loss of biodiversity, additional resources should be made available by the Government to ensure sufficient staff are available to assess these sites.
- The Landscape Strategy GIS databases may assist with this assessment, but many habitats of interest, especially wet hollows, may lie below the threshold imposed by the minimum mapping unit used in each layer in this system.
 - County biodiversity surveys, as currently being undertaken in Co. Offaly, should be incorporated into the Landscape Strategy GIS.
 - Knowledge of local people and experts should be tapped. The approach to a new site should be to ask first, "who knows about this site?"
- 4) Development of spatial databases for rare plants and animals would assist in protecting them.
- Each habitat should have a generic biodiversity action plan developed by professional ecologists and available to licensed foresters.
 - These rare species and other flagship species can be incorporated into public information and education about biodiversity and conservation.
- 5) Incentives should be provided for the conservation of non-designated habitats within and outside the REPS.

Benefits to heritage

Biodiversity will be maintained through the identification and preservation of areas of ecological value, both forested and non-forested.

3.2.4.3 Existing forests in unsuitable locations

Irish people today have inherited forests located in areas that today would probably not be planted, particularly peatlands. Many such sites bear trees which have performed poorly. These sites may be exposed and have shallow effective rooting depths, making the trees prone to windthrow, which may be not just unsightly and but also dangerous for operators to clear. In addition, soil and water ecosystems on these sites may be particularly vulnerable to damage from forestry operations.

Coillte has developed a protocol for the identification of sites that should not be restocked with commercial conifers for economic, environmental and/or social reasons. A total of 43,950 ha of forest sites on western peatlands have been identified as better suited to environmental forestry, the management of which focuses on their environmental and social contribution. A decision support system has been developed to assess the economic, environmental and social aspects of each site. The following options are proposed for such sites:

1. Restoration of blanket bog/heath in areas that have peatland restoration potential, i.e. afforested sites that retain wetland hydrology and flora; and in riparian buffer zones where potential natural vegetation is open blanket bog or heath.

2. Retention of forests (to age of maximum mean annual increment (MMAI) or Long Term Retention (LTR)) can benefit some species of wildlife, particularly if these forests are managed in a way that allows them to develop a more "natural" structure, e.g. trees dying off and replaced by young trees from natural regeneration, as the site allows. Most selected areas in this category will have poor productivity, poor access and poor timber quality.

3. Replacement of conifer forest with native forest or scrub for environmental reasons is very much dependent on site and soil conditions, as survival of broadleaves is hotly debated. Fallowing and delaying replanting may be practised on these sites to forestall problems with pine weevils without recourse to pesticides.

4. Coillte expects some areas to be reforested with conifers, depending on the assessment of all aspects: productivity, environmental and social. For example, Coillte reports that forests currently of $YC \geq 12$ should be considered commercially viable using conventional restocking unless there is a justifiable net environmental gain in sensitive areas to manage the area as an environmental forest.

Alternative methods will be considered, such as the use of natural regeneration, particularly of lodgepole pine. This is a low cost restocking method with supplementary filling-in or re-spacing, as required, to achieve management objectives, as well as delaying harvesting to MMAI. (As lodgepole pine can colonise open heathland and bog, it should be monitored to ensure it is not damaging valuable open habitat.) Increasing the age and structural diversity by restructuring is also planned. As many of these forests are

in the uplands or areas visited for recreation and tourism, landscape issues will also be taken into account by:

- restructuring the age profile,
- adjustments to coupe shapes and sizes,
- lowering the tree line in visually sensitive areas,
- interrupting the straight edges of forest plantation by leaving strategic areas unplanted at the restocking stage, and
- incorporation of locally native forest species into conifer forests.

Coillte (and the Forest Service) are currently unsure whether peatland sites can support native broadleaves. Indeed, the Forest Service's Indicative Forest Strategy may not favour the development of broadleaved forests in the West. However, it is probable that scrub, parkland, and small stature forest would have existed naturally in some areas if they were not grazed, while bog is the climax vegetation on deeper peatland sites. While it is accepted that only a proportion of the western peatland sites would support broadleaves and would have little commercial value, there is good potential for creating new, large scale, native forest reserves. There are fewer opportunities for the establishment of such reserves on 'green field' sites elsewhere. This option could begin to make some difference to the highly fragmented native forest resource. Development of large native woodlands, and the redesign of the upland forests, would also be a positive contribution in line with the requirements of the Forest Stewardship Council (FSC) certificate held by Coillte.

The feasibility of securing natural regeneration on these sites and the factors influencing this process remain contentious. Natural regeneration could be a suitable restocking option, producing new forests with a greater degree of structural variability and consequently higher biodiversity and aesthetic value.

The strategic planning of forestry in the landscape also affects forests that should be restored to other habitats. The vast majority of these sites are State forests on

blanket bog, managed by Coillte. Some are in the headwaters for riparian zones of ecological interest for fish or mussel species. Currently, there is a legal requirement under the Forestry Act 1946 to replant these areas. Restoration of blanket bog will also potentially restore the methane-containing function of this non-wooded ecosystem.

Some of these sites have become targets for windfarms. If such a site is unviable for commercial forestry because of high rainfall and poor peat coherence, it is likely that other developments, which include roads and deep excavation, will have drastic effects. Blanket bog has a complex hydrology which can be affected by development. Such fragile sites should be earmarked for restoration as blanket bog or native forest.

Recommendations for existing forests on peatland sites

- 1) The obligation to replant in environmentally sensitive areas should be relaxed.
 - If replanting is required, it should be with native species. Alternatively, invasion into existing plantations by birch and other natives such as rowan should be welcomed. Some, such as birch, can be managed as a third species for timber or fuel.
- 2) The Forest Service definition of forest should be revised to include Scots pine parkland and widely spaced forest similar to that in Scotland.
- 3) Landscape aesthetics and upland recreation should be major considerations in management of upland forests (see Section 3.1.4.1).
- 4) Hydrology and soil issues must be thoroughly considered when planning a change of use from forest to other land uses, such as wind farms.
 - Planning permission for other development should be preceded by a felling licence.

- 5) The region-specific studies as represented by some academic work such as the BIOFOREST group should be taken on board by foresters, forest managers, and the Forest Service. Further ecological survey work should continue to be funded.
 - Research is needed on broadleaves and long term dynamics on peatland sites (see Section 3.6.5).

Benefits to heritage

There will be many benefits, including the restoration and retention of some habitats, as well as potential development of a large native forest resource for environmental reasons, while maintaining many of the productive forests in the West.

3.2.5 Conserving and expanding native forests

It is desirable and appropriate to expand the area of native forest. The recent National Parks and Wildlife Service (NPWS) 'National Survey of Native Woodlands in Ireland' records a total of 77,047 hectares of native forest (excluding scrub) in Ireland, which mainly small, fragmented patches. Of this area, approximately 6000 hectares of native forests are protected under the Natura 2000 designations. All Annex 1 forests are being monitored under the Habitats Directive with regard to impacts and threats. In the event of a negative assessment, the State is obliged under the Habitats Directive to undertake remedial action. The Directive also requires that the NPWS sets a target area for expansion of the habitat as well as a mechanism by which this will be achieved. For example, the total area of old oak forest in Ireland is approximately 4500 hectares; the proposed target area is 22,000 hectares.

Five types of native forest and scrub occurring in Ireland are listed on Annex 1 of the Habitats Directive (yew, old oak woodland with hard fern and holly, bog woodland, alluvial forest and juniper scrub). Other types of native forest should also be conserved and expanded.

Reasons for increasing the small area under native forest cover, especially with consideration of corridors and the Landscape Strategy, include:

- increasing populations of forest species;
- increasing the exchange of genes within and between populations, thereby increasing its resilience in future stress and shocks;
- establishing larger areas of deep forest suitable for forest specialists;
- establishing a greater number of edge habitats and mosaics of different ecosystems, thereby supporting species which need more than one habitat, as well as supporting species which have an extensive range;
- improving hydrology; and
- soil improvement (e.g. birch is well-known as a soil improver).

Native forests can fulfil a number of functions. For example, many native tree species can be grown for timber and some species are much in demand. Wood for fuel is becoming increasingly important. However, some native forests, should be non-intervention areas. Native forest is also likely to blend into the landscape visually. Small forests may become stepping-stones, connecting wooded habitats in the landscape. Finally, wooded strips along riparian and lake systems in some cases may also flood and be similar to the alluvial forest protected under the Habitats Directive.

The Native Woodland Scheme (NWS) is currently the main funding mechanism for native forest conservation and expansion. The NWS was launched in 2001. As of August 2006, 126 projects were approved under NWS Element 1 'existing forest', totalling 2590 hectares, and 35 projects under Element 2 'new native woodland', totalling 340 hectares. The NWS was suspended at the end of 2006, although there are additional applications, amounting to 3000 ha, have been lodged with the Forest Service, in anticipation of its reintroduction.

The NWS has beneficial ecological and social effects. It has not only assisted

owners to protect and expand the area under native forest, but has also increased the value of forests among wider society. A further benefit has been in the development of knowledge and practice in native forest establishment and functioning. The NWS sets out guidelines for appropriate native forest conservation and establishment methodology. It has fostered working relationships between foresters and ecologists and has raised the profile of native forests within the forestry sector as a whole. These and other, new skills, need to be fostered and should continue to be incorporated into best management of native forests for multiple functions.

In recent times, changing demographics have resulted in some abandoned agricultural land being colonised by scrub. This natural succession to forest (depending on soil depth) could be hastened by management to create an irregular structure with a variety of species. Consideration should be given to open space and glades within the developing forest, depending on the surrounding landscape. In an undisturbed landscape with approximately 80% forest, windthrow, fire, disease, and other factors would ensure the development of gaps and new stands of young trees, but this process cannot operate in the same way in a landscape greatly affected by human use. This means that some small in-forest habitats may be lacking in the modern landscape. Canopy type is a major factor affecting forest species, but ground flora, soils, and other factors also influence the species that occur.

The NWS could be used in combination with the Landscape Strategy (see 3.2.4 above), to identify suitable areas of native forest expansion for multiple functions. Some of these may be second rotation sites now deemed unsuitable for conifers for environmental, economic or social reasons. The original concept of the Peoples Millennium Forests Project was to secure four large, new national native forest reserves (one per province). An initiative to secure such large-scale reserves could be the best way to increase

Ireland's very low native forest cover. Landowners, rural organisations and local communities acting together may be able to assemble large parcels of land for such reserves. Woodlands of Ireland could be the most appropriate forum in which to discuss this proposal.

Recommendations for native forests

- 1) The NWS should be available for any suitable site, regardless of location. However, to maximise the broader impact of the Scheme, strategic targets should be set to locate NWS applications in areas where the highest positive impact can be made.
 - This can be done using the Landscape Strategy GIS (see Section 3.2.4) and considering defragmentation, protection of water courses, and other functions.
 - Agencies such as NPWS, Fisheries Board, Forest Service, and local authorities should join forces to strategically identify sites.
- 2) There should be an incremental increase in the Scheme's budget to facilitate a steadily developing programme of conservation and expansion.
- 3) There must not be any further hiatuses in the Scheme, such as occurred in 2003 and 2007. These have been disastrous for confidence-building. Continuity may be best achieved by multi-annual budgets and rolling over of forestry programmes until new programmes are finalised.
- 4) A native woodland advice and support programme should be instigated.
 - Owners of sites identified as strategic should be approached, perhaps by local authority Heritage or Biodiversity Officers, to inform them about the scheme and encourage consideration of contributing to a native woodland network.
 - Support for owners to maintain their native forests will be another essential element of this programme.
- 5) Continued financial support for the NWS may only be effective if there is a technical support programme in place to disseminate the scheme, and to educate and encourage landowners and managers to become involved in native forest development and management.
- 6) Other native woodland development, such as commercial afforestation using native species for timber or fuel, should also be encouraged.
- 7) The Forest Service and local authorities should actively protect existing forests from development using existing legislation, such as the Forestry Act, 1946, or by refusing planning permission where it would involve destruction of any native forests.
- 8) Following the completion of the native woodland survey, and considering the objectives to halt loss of biodiversity loss by 2010 as well as obligations under Article 6 of the Habitats Directive, NPWS should develop a strategy for native woodland conservation and expansion.

Benefits to heritage

A programme of well-designed expansion of native forest will result in an expansion of forest habitats and species diversity. It will also contribute greatly to the landscape, improve soils and hydrology, provide new spaces for recreation and provide timber and firewood. Ongoing support for owners will help ensure the perpetuation of these new and expanded native woodlands.

3.2.6 Co-ordination of incentives, such as the Rural Environmental Protection Scheme and forestry schemes

Strategic planting can be promoted through the use of incentives. The Rural Environmental Scheme (REPS) was first introduced by the Department of Agriculture in 1994, and it has been revised on a number of occasions since. The original scheme, which operated from 1994 to 1997, did not allow for afforestation on land which had been entered for the REPS. Since 1997, this rule was changed to allow farmers transfer some of their land to forestry while entering the remainder of the farm into the REPS. The revision of the previous measure was brought in because the REPS was seen as too competitive with afforestation schemes. It is well known among REPS advisors and other agri-environmental specialists that farmers usually reserved their worst land — from a farm productivity viewpoint — for afforestation. In contrast, biodiversity researchers have recommended confining planting to the more intensively-managed areas, such as improved grassland. The marginal farmland often — but not always — corresponds to that which is most ecologically valuable. It may include such habitats as wet grassland, cutover bog and heather moorland. Afforestation significantly alters these habitats.

Up to 2007, afforestation of many REPS farms implied plantations for timber under the Afforestation Grant Scheme, which is directed very strongly towards particular species and assumes the prime objective to be a timber crop harvested by clearfell. The functions of forests on farms can be much wider: shelter for livestock or building, fuel, production of timber through continuous cover silviculture, ecological corridors, landscape aesthetics, or a sense of place. The existing grant structure has not always included follow-up advice, resulting in many unthinned private plantations which will be unable to produce quality timber. In 2007, the FEPS scheme was introduced on a pilot basis. This scheme, which is available only to

farms in REPS, widens the choice of tree species and introduces a requirement for open space. Although certain habitats are promoted, there is no requirement for input from a qualified ecologist.

A REPS farmer must have a plan and is dependent on the advice and expertise of an agri-environmental planner. Consultations with a number of agri-environmental specialists reveal that the REPS and the current forestry grant schemes are still competing with one another, as viewed from biodiversity and species-conservation perspectives. Within the REPS, there is no funding for specific management of existing forests. In such cases, Forest Service grants must be applied for. Designated sites are protected, but many species and habitats survive outside this site network, and it is these areas which are the target for grant-assisted afforestation. Since such sites are not designated, there is no administrative or financial mechanism whereby farmers can be rewarded for conserving their worst land, which is often of more nature conservation value than other parts of the farm. Since the current Afforestation Grant Scheme offers a strong incentive, advisors who advise against planting such land are seen to be putting the farmer at a disadvantage. Even FEPS does not address the threat to remaining areas of high nature conservation value. It is still focused on afforestation, albeit in a more environmentally-sympathetic manner.

The situation in the Republic of Ireland is in contrast to that in Northern Ireland, where special incentives are offered for conservation of habitats within agri-environmental schemes; this makes it more financially worthwhile to conserve them rather than convert them to forestry.

Some of the reasons for this loss of biodiverse open habitats to forest were reported in a review of the CAP Rural Development Plan 2000-2006, commissioned by the Heritage Council:

- Afforestation is still strongly driven by a quantitative target of hectares to be planted, with site assessment of the biological diversity value of the land

identified for planting virtually non-existent.

- The failure of the Code of Best Forest Practice to address the local consequences for biological diversity on land use change associated with farm afforestation is a major weakness.
- Forest grants are attractive due to the lack of a ceiling to afforestation payments, their tax-free status, and the actual or perceived lack of paperwork and sheer bureaucracy compared to REPS.
- Although many farmers would not contemplate forestry themselves, the scheme could introduce an economic incentive for farmers to sell off parts of their farms to entrepreneurs, depending on the market with regard to land prices.

Although strategic planning may appear at first glance to remove the landowner's power to choose, certain choices are left. A whole-farm approach will permit zoning of different functions within the farm, and it is expected that consultation with the affected groups will result in a greatly improved REPS scheme.

Recommendations on the REPS and encouraging farmers

- 1) A whole-farm approach should be taken when planning potential afforestation.
 - Planting native trees and other broadleaves where appropriate for a variety of objectives should be encouraged.
 - All the benefits a forest may offer to the farm enterprise need to be considered, including timber, fuel, shelter, recreation, landscape enhancement and contribution to a sense of place.
- 2) This also requires continuing training of REPS planners, since they usually have the most contact with, and influence on, the farmer's REPS plan.
 - REPS and FEPS should require separate input from qualified

ecologists. This is necessary because ecology is a separate profession; it should not be assumed that other land managers, such as agronomists, foresters, or horticulturalists have the necessary skills to advise on ecology.

- Incorporation of ecological expertise, along with additional training of FS inspectors and other advisors in ecology, will promote forest planting for biodiversity and habitat.
 - Follow-up inspections by ecologists would help encourage adherence to management plans.
- 3) Since REPS planners often identify land suitable for afforestation, they should have access to the Landscape Strategy (expanded IFS) and receive detailed training in the NWS and FEPS.
 - 4) Information on habitats of high nature conservation interest for landowners and advisors is needed, to overcome the belief that if a site is not designated, it is without ecological value.
 - Incentives should be provided for the conservation of non-designated habitats within the REPS.
 - 5) A mechanism needs to be developed whereby afforestation may be refused grant-aid in certain specific sites outside the network of designated sites.
 - If afforestation is to be refused, some form of funding for suitable alternatives needs to be made available.
 - 6) Forest Service schemes should be designed in consultation with all interested groups, including farmers and ecologists, to avoid competition with or conflict between various schemes.
 - This could take the form of a broadly based technical working group followed by two-way consultation.
 - 7) A broadening of the concept of forests should be considered. Some new forests may act as shelterbelts and wildlife corridors, rather than solely as

timber crops, contributing to farm productivity and ecological integrity.

- Agroforestry systems, in their broadest sense, should be investigated and considered as a means to encourage farmers to plant broadleaves on their farm (silvopastoral, silvoarable, riparian buffer strips, shelterbelts, parkland, avenues, etc.).
- 8) The impact of the REPS on forest biodiversity needs to be monitored.

Benefits to heritage

More consideration of biodiversity on the farm, in both open and wooded areas, will help to develop a culture of integrated land management.



3.3 Forest Management

Forest management as planned and implemented by foresters, forest owners and forestry contractors fundamentally affects the heritage value of forests. Therefore, it is critical that these three groups are aware of the heritage implications of their decisions and actions. Forest management is normally driven by owners objectives based on advice and guidance from foresters, regulatory and advisory bodies. The forestry profession has particular responsibility in this matter, since foresters normally advise forest owners and instruct forestry contractors on forest management.

3.3.1 Progress to date

The Forest Service has published a Code of Best Forest Practice to guide foresters and contractors. A National Forest Inventory has been completed by the Forest Service, which allows analysis at a generic level of the intensity of forest management currently practised. The national forest resource is maturing, and we are presented with a timely opportunity to further develop forest management and related skills in Ireland. To this end, a number of private owners are managing their forests under continuous cover systems, while Coillte has also implemented continuous cover in certain of its stands.

3.3.2 Management planning

The drawing up, agreement and implementation of forest management plans by foresters is central to the development of forest management. The forest management plan may be supplemented by specific plans for operations such as afforestation, harvesting, road development, etc. All of these plans should be based around the forest owner's objectives and should take site conditions, inventories, designations and other land uses into account. Where appropriate, they should involve consultation with other forest users, neighbours and relevant affected bodies

such as fisheries boards, local authorities and the National Parks and Wildlife Service.

Currently, all grant-aided afforestation projects require an afforestation plan covering years 1 to 4, which is contained within the Forest Service Form 1 Application for Approval. Subsequently, the Forest Service require the production of management plans covering years 4 to 10 (submitted in year 4) and 11 to 20 (submitted in year 10) for coniferous forests greater than 10 ha in area and broadleaf forests greater than 5 ha. The template plan provided by the Forest Service from year 11 to 20 is currently in the form of a checklist with very limited information gained about the management objectives, inventory or nature and scheduling of operations. In contrast, implementation of a system of comprehensive management plans and related inventories would result in a dynamic national forest inventory and production forecast that is constantly being updated and that would deliver local results based on local measurements and forest owners' objectives and plans.

Forest plans should address the changing nature of the forest as trees grow, and the regulations on planting patterns should be flexible to accommodate forest dynamics over time. All operations should be planned, giving the owner a reference with which to make provisions for the appropriate work to be carried out. Areas of ecological concern may be marked for minimum intervention. Timely thinning and pruning would be encouraged, and this may help with forest health, for example, as pruning and thinning can help reduce humidity in the forest interior and therefore the habitats for some fungal diseases. Biodiversity generally should benefit with frequent thinning, since more light will reach the forest floor. Timber quality and access to thinning for fuel will also be improved.

Recommendations on forest management

- 1) All private forests should have a forest management plan, produced to a standard agreed with the Forest Service. The plan should include:
 - the forest owners' objectives,
 - site conditions such as soil and fertility conditions, elevation, rainfall
 - inventories of the resources on site,
 - designations and habitats of ecological interest, and
 - other land uses.
 - Consultation with statutory consultees and stakeholders with a relevant interest in or knowledge about the specific plan will be required in drawing up the plans, and their content and implementation should be subject to audit by the Forest Service.
 - The plans should be consistent with requirements for forest certification in order that forest owners can participate in group certification schemes, should they wish.
- 2) The inventories and production forecasts associated with such plans should be used in the National Forest Inventory to provide qualitative and quantitative data at a local level, based on actual management plans and owners' objectives.
 - The mandatory return of detailed multi-resource inventories and plans for all sites, to an agreed standard, will provide valuable information on the objectives, silvicultural systems, non-timber products and services and planned production / potential for all sites. This, with appropriate auditing by the National Forest Inventory team in the Forest Service, could be used as a data source for the National Forest Inventory and local, regional and national production forecasts. It would also give the owner and the forester opportunities to ensure they are planning necessary tending and other management operations in a timely and ecologically appropriate manner. The inventory and plan could be updated for all forest properties every 10 years. The exercise could operate using a system of licensed foresters (see Section 3.5.5) engaged by the forest owner but paid by the Forest Service for the delivery of multi-resource inventories and plans to a required standard.
- 3) Forest management plans should be drawn up within the framework of current legislation, best forest practice, environmental guidelines and consultation with the appropriate bodies and stakeholders. These guidelines should be kept under constant review to ensure they reflect best practice and that forests develop as multifunctional resources balancing economic, ecological and social objectives. Foresters should be responsible for the plans (including operational plans such as afforestation, harvesting and road-building) and should submit complete plans, including all relevant consultations to the Forest Service for grant approval. The current system of central referral by the Forest Service is failing to develop relationships between forest managers and stakeholders / prescribed bodies on the ground, and this is to the detriment of the understanding of local issues of concern, the building of local relationships and trust and the long term development of the forestry profession.
- 4) Foresters should take responsibility for the full compilation of management and operational plans, including all consultations with relevant bodies and stakeholders. The central administration of such consultations by the Forest Service should cease. This will lead to the development of greater local understanding and relationship building on the ground between all those concerned with a particular site.
- 5) There needs to be a national push towards greater awareness and implementation of later forest management, particularly thinning, involving training (from outsourced professionals) and demonstration for

foresters, forest owners and forestry contractors (see Section 3.6.2 on Training and Education.) The economic and ecological benefits of thinning need to be clearly demonstrated and emphasised.

Benefits to heritage

A requirement for a current, professionally drawn up and agreed management plan for all forests will do much to protect and enhance the heritage values associated with forests. It will mean that, over time, all forests will have a multi-resource forest inventory, a plan designed to balance the provision of timber and non-timber products and services, and sufficient data collected for participation in a forest certification scheme. The placing of responsibility for consultation on foresters will lead to the development of greater understanding of and respect for local heritage issues and the building of relationships between professionals on the ground where it matters most.

3.3.3 Thinning

Over the past 20 years, there has been a strong emphasis on afforestation and the building up of a national forest resource. Most of these new forests are privately-owned. Many are maturing as timber crops and as new habitats, recreation areas and part of a changing Irish landscape. The forestry sector should be structured in such a way as to support the further development of these new forests in a manner which protects both the interests of the forest owner and the national heritage. Unfortunately, there is relatively little knowledge and experience of later forest management in the private sector. This is reflected in the disturbing statistic from the recent National Forest Inventory that less than 10% of private forests and less than 30% of public forests were in receipt of thinning, where thinning was an option. This has wide-reaching implications for the commercial forestry sector (sawmills, contractors etc.) and for the enhancement of biodiversity in conifer plantations. Clearly, a huge effort is

needed to promote thinning and to develop skills in this process amongst foresters, forest owners and forestry contractors (see Section 3.6.2 on training and education). Currently, there is quite a long lead-in period to thinning operations, in particular the first thinning, which includes developing access, cutting inspection paths, obtaining a felling license, pre-sale timber measurement, and finding a harvesting contractor and / or timber market. Any policy initiatives that can ease this process and shorten the lead-in time should be seriously considered, such as removing the need for a felling license for thinning as prescribed in a management plan and supervised by a licensed forester.

Recommendations on forest thinning

- 1) Licenses should only be required for clearfelling or thinning in sensitive areas. Those forests which are under a management plan prepared by a licensed forester should not require a felling licence.
- 2) Thinning should be promoted, with emphasis on the economic and ecological benefits and training for owners.

Benefits to heritage

In general, thinning should result in both economic and environmental gains. Any efforts made to promote and encourage this practice should have beneficial results.

3.3.4 Harvesting timber

On sites where timber or fuel is an objective, there are many options for harvesting and extraction. Each option will generate environmental impacts, especially soils. The type of thinning, the species used, and size of gaps created in the canopy for regeneration will also have impacts. These should be considered as part of the management plan or even the afforestation plan.

3.3.4.1 Implementing various non-clearfell silvicultural systems

Clearfelling followed by replanting is the main system used in Irish forest management. Increasingly, alternative systems are being considered, because they can achieve multiple objectives simultaneously, such as maintaining visual appeal, maintaining the recreation forest experience, responding to public concerns, and reducing the environmental impact of forestry practices on water quality and biodiversity. Alternative systems may include close-to-nature silviculture, where the objective is to mimic the natural disturbance, or a set of techniques designed to retain much of the canopy, often referred to as continuous cover silviculture (or continuous cover forestry, or CCF). CCF is not a single system but a suite of silvicultural techniques which have been in use in many parts of the world for centuries. It should not be assumed that CCF is ecologically beneficial simply due to associations with the term. Other systems include coppice, in which small diameter roundwood is produced by cutting certain broadleaves, such as hazel or alder, on a short cycle. In well-implemented CCF systems, the focus is on forest structure and the potential for regeneration and growth of individual stems. This may be achieved through the use of felling coupes, leaving seed trees, and many other techniques. The system should suit the site and objectives.

Alternative silvicultural systems are capable of providing many benefits, including:

- landscape continuity;
- soil, water and forest protection;
- forest habitat continuity and protection; and
- savings by increasing the proportion of large-log production as well as reducing costs.

Timber quality may be enhanced also, due to control of juvenile wood production. Implementation of CCF is likely also to

help reduce impacts aggravated by clearfells, such as high populations of the large pine weevil (*Hylobius abietis*), which breeds in stumps and emerges to eat the bark of young transplants, which may then die.

In the Irish Forestry Standard, one of the Sustainable Forest Management indicators is “the area of forest managed for continuous cover”. The Forest Service’s Code of Best Forest Practice distinguishes between felling coupes under and over 25 hectares and recommends larger coupes in valley bottoms or on rolling terrain. More sensitive areas are better suited to coupes limited in size from five to 15 hectares in the Code, which suggests the coupe size should be guided by the size of the forest or water catchment. The Forest Service Landscape Guidelines also encourage the use of ‘alternative silvicultural systems’ such as group, selection and shelterwood systems, to mitigate the negative impact of harvesting on the landscape. The Biodiversity Guidelines encourage promotion of smaller coupes and diverse species and structure. The Native Woodland Scheme promotes the use of lower impact systems, while the Code of Forest Practice mentions the potential of coppicing as a means of management for small-scale production of craft-based products.

The prevailing belief in the forestry industry is that any system of harvesting other than clearfell will lead to windthrow. However, a number of other factors contribute to windthrow, including rooting depth, soil depth, tree species, root health, forest composition and structure (mixed-species, mixed-aged stands show better resistance) and severe storms. Mixed-species, mixed-aged stands exhibit better resistance. Storms are likely to increase in severity as the climate changes. Continuous cover systems are linked with greater stability, although the transformation of even-aged plantations to CCF can be somewhat risky. Even if they are conservative, alternative systems can be practised successfully in all forest sites where successive thinnings can be carried

out, provided there are no other limiting factors. The main site factors which mitigate against thinning are exposure, soils and accessibility. Currently, there are no reliable data to quantify the proportion of forest land in Ireland which is thinnable but it is likely that most broadleaved and mixed stands and possibly over 50% of conifer stands are thinnable. Currently, only 10% of private forests and 30% of public forests have been thinned. Research suggests that thinning of plantations, and therefore transformation to CCF management can precipitate windthrow. However, irregularly structured stands tend to be more resistant to windthrow and the practice of frequent intervention in these stands allows the opportunity to clear up any windthrow damage that might occur.

Coillte has developed policies to address these issues, stipulating that 'old forest sites' (sites which were wooded on the First Edition Ordnance Survey maps, dating from the 1830s and 1840s) should be managed using what are referred to as low impact systems. In practice, old forest sites, biodiversity areas and amenity areas have been so designated. In addition, approximately 1000 hectares have been designated for continuous cover forest transformation on stable conifer sites and as demonstration sites. Generally, CCF still represents a very small proportion of Coillte's management but this area is increasing annually as more sites are identified and knowledge increases.

Evidently, although only one form of silviculture is supported in Ireland, the use of alternatives is increasing. This trend has been encouraged by, for example, meeting the requirements of FSC certification, increased public demand for alternatives to clearfelling and the desire by some private growers to maintain silvicultural options rather than relying on a single system.

Many of the incentives and constraints in Great Britain are similar, if not identical, to those in Ireland, and interpretation of the FSC certification requirements is similar. As in Ireland, much of the effort of forest

planning is directed towards forest redesign of succeeding crops to facilitate smaller coupe sizes based on established landscape design principles. One of the main drivers has been impact of felling on the visual landscape. In practice, coupe sizes have been larger in upland areas, while smaller coupes and alternative systems have been implemented in lowland areas and valley sides. The normal practice has been to avoid felling adjacent coupes until the original coupe has been successfully established.. This has often reduced the worst effects of clearfelling but can also lead to forest fragmentation, which may be problem for arboreal species that need a high level of forest connectivity, such as the red squirrel.

The trend in Great Britain has been to progressively reduce clearfell sizes while at the same time increase the area managed under alternative silvicultural systems. The effect of this may be to improve the buffering capacity of individual forests as well as general landscape improvements. However, very little has been studied on the effects of coupe size on biodiversity and conservation of forest species in plantations in the UK and Ireland. In Northern Ireland, guidelines recommend the reduction of clearfell coupe sizes to help avoid the fragmentation of red squirrel habitat. In a landscape as denuded of forest cover as Ireland, the maintenance of the forest habitat within the existing patches may contribute to conservation of forest species.

In private forests, alternative silvicultural systems are also practised by a small minority of forest owners, where it helps to achieve the individual owner's objectives. Such systems are promoted and supported by Pro Silva Ireland. Alternative silvicultural systems can be practised on any suitable sites and are particularly suited to small, privately-owned forests, as demonstrated by farm-foresters in Switzerland and other countries. However, poor access to many farm forests in Ireland may limit the opportunities for long-term management of any sort. The forestry

subsidy system is well-developed and has proved itself to be an effective incentive to achieve forestry aims. There are no incentives that specifically support alternative systems. In Wales, for example, the Wales Woodland Strategy has a specific target for continuous cover forestry, and there are specific grant packages aimed at facilitating achievement of this target within the private forestry sector.

The development and adoption of alternative systems is not limited solely by site-based constraints. Lack of information and experience may well be important limiting factors. These problems are compounded by a limited professional capacity at all levels to implement such systems, which appear to be more complex than clearfell/replant. Furthermore, there is a lack of yield models to forecast predicted yield from forests managed in this way. Ireland has been successful in attracting significant investment in sawmilling, processing and manufacturing based on a high level of confidence in timber production forecasts from uniform plantations based on predictive yield models and field survey. This is currently not available for stands managed using alternative systems and could reduce investor confidence. Furthermore, there may be a perception amongst sawmillers in particular that alternative systems 'lock up' valuable timber supplies or that the sawlogs produced are 'over-size'. In other countries where such systems are commonly practised, an organisation or individual often acts as an authority on the subject and can provide advice as well as leading on research and publication of locally relevant papers and articles.

Recommendations on alternative silvicultural systems

Incentives for alternative silvicultural systems

- 1) The Forest Service should promote alternatives to forest owners and foresters beyond clearfelling and replanting. Restructuring of current

single-aged plantations should be permitted and supported.

- 2) Close-to-nature and CCF systems should be actively encouraged by creating an incentive package that encourages alternative silvicultural systems on appropriate sites.
- 3) Afforestation schemes should take early plantation design for CCF into account and support this. Transformation at a later stage is possible but more facile if planned from the outset (or from first thinning).

Promotion of alternative silvicultural systems

- 4) A 'CCF champion' should be based at a forestry institution to teach, research, publish and to be available to provide advice to growers and foresters. COFORD, the Forest Service or Teagasc could employ such a person.
- 5) Promote greater exchange with countries in which CCF is practised, such as Slovakia and Austria, through professional societies and third-level forestry institutions.

Advice, training and research

- 6) The Forest Service should support training of forest managers, workers and contractors in implementation and practice of alternative systems.
- 7) A network of demonstration sites on a variety of site types throughout Ireland could be developed. These could be used for research and for training.
- 8) Advice and technical knowledge should be made available to farmers, other forest owners, and sawmillers.
- 9) The current scope of research should be extended, to include growth and yield models for irregular conifer stands; CCF systems within native forests; range and shape of coupe sizes, and implementation of single-tree selection; ecological impacts and benefits of alternative silvicultural systems; application of alternative

silvicultural systems for small-scale forests; and application of coppice and pollard systems to use on farms for timber, fuel, and biodiversity.

Benefits to heritage

Progress in the implementation of continuous cover and close-to-nature systems will increase the ecological and recreational value of Irish forests, contribute to the forestry knowledge base, and improve timber quality and regularity of supply.

3.3.5 Threats to Ireland's forests

3.3.5.1 Invasive and emergent pests and diseases

Forests may be viewed as islands capable of colonisation in a similar manner to the classic study by MacArthur and Wilson (1967). Colonization of forests has been demonstrated⁵⁰ to relate to the size of the resource (forest area) and trade with external partners in the form of goods or tourism.

The recent rise in Ireland's prosperity has resulted in increased trade, tourism and expansion of the management of natural resources, and colonisation models predict this to cause greater risk to the forest estate. Records from the Forest Health and Protection Laboratory demonstrate that exotic organisms are colonising Ireland's forests. In some cases, the treasures of biodiversity may be threatened simply due to high numbers of visitors who are not aware of needs to prevent spread of spores and eggs. In recent years, the causative agent of Sudden Oak Death (*Phytophthora ramorum*) was identified in Killarney National Park and several other sites in the south of the country⁵¹. In 2006, a specimen of common alder was suspected of being infested with the rust fungus

Melampsorium hiratsukanum. If confirmed, this would be a new record for Ireland. In addition, the introduction and spread of Knopper Galls on oaks in Ireland has been confirmed by the GMIT Forest Health and Protection Laboratory. The causative agent of this gall is a small wasp, *Andricus quercuscalicis*. We are fortunate in Ireland that the alternate host for this wasp is not common, since our forests could suffer periodic damaging outbreaks of this insect if it were widespread. Evolution is still occurring, of course, and at any stage these organisms may alter their relationships with each other or the environment, resulting in a potentially catastrophic impact from any one of the invading or emerging biotic threats.

Other diseases appear to be increasing in impact. The Oak Mildew (*Microsphaera alphitoides*) appears to be becoming more common and virulent in some cases. The Laboratory has recorded severe outbreaks of this fungus in plantation oak forests in Ireland. This fungus was introduced into Britain in 1908 but no first record is readily available for Ireland. It may have been self-introduced with the spread of susceptible hosts (oak) or introduced with imported plantation stock. Without doubt, this is an unmeasured risk. No baseline study exists for these or other recent introductions.

Another unmeasured risk is the introduction of exotic conspecific material for plantation hardwoods. A recent example is the accidental and widespread introduction of brown bud ash (*Fraxinus angustifolia*). This species was introduced as *Fraxinus excelsior*, the only ash native to Ireland (with black buds). Brown bud ash is more susceptible to disease and insects, and also has very bad form i.e. is coarsely branching. It also readily crossbreeds with *F. excelsior*, leading to a reduction in insect pest and disease resistance and change of tree form. These are just a few examples of past and present threats.

In addition to the spread of diseases and pests, the change in climate that is already

⁵⁰ See Walsh and Kay (1995)

⁵¹ e.g., O'Connor, Gosling and Walsh (2005)

occurring will alter the suitability of Irish forests for a variety of invertebrates, fungi, and other organisms which have the potential to become pests in Irish forests. These may include both invasive introductions and organisms which have been present but emerge as new pests. There are already reports of some invertebrates producing two generations instead of one, in a single year in Northern Europe. For species that produce many young who may normally die off but can explode into a huge population if the conditions are right, this presents a serious potential problem. In addition, trees which grow rapidly, as is the current focus in Irish forestry, produce fewer secondary compounds, so they exhibit reduced defence against pests. Early detection of invasive or emergent pests is of the utmost importance.

Although a definitive prediction is premature, it is likely that Irish foresters and forests will have to adapt to an environment with:

- Increased CO₂ levels
- Increased temperatures
- Increased storm frequency
- Decreased rainfall, particularly in summer
- Increased nutrient mineralisation
- Increased exposure to forest pests and diseases
- Increased risk of forest fire

Forest decline can be broken into three phases: predisposing factors, such as tree age; inciting factors, which are stresses which can begin the decline process; and contributing factors, such as insects and disease, which drive the changes to completion. The change in climate may result in some trees being on sites which are on the edge of their range of tolerance, stressing them. A stressed tree is more susceptible to infection or infestation. Given that models of future climate change vary depending on controllable variables, the most reasonable approach is to plant a diversity of species with slightly different preferences, and using national rather than local provenances. Species which are disadvantaged by the changes in climate can later be removed

or reduced in proportion in thinning. Younger trees are more resilient in the face of pests and diseases, indicating that diversification of age structure of each forest will help protect it in the face of these challenges.

The elements of climate change cannot be treated in isolation and how they interact will be as important as any individual factor. The future changes have implications for the following:

- Species and provenance selection
- Location of forests
- Forest establishment and management
- Harvesting and transport
- Silvicultural systems
- Forest health and protection
- Carbon sequestration
- Research and development

Some threats to Irish forests are controllable, such as silvicultural options for mitigation of known pests and diseases. For reasons of biodiversity, it is desirable that the use of chemicals in forestry should be reduced, and yet it is expected that biotic threats may increase with climatic-related stress. For many of the existing pests, such as pine weevil, cultural methods of small coupe felling and use of fallow periods should be used. Alternatively, a complete justification for not using these should be made on a case-by-case basis, together with a financial justification which includes valuation of environmental damage as a financial cost. In addition, the level of knowledge must be constantly upgraded in order to keep pace with potentially continuously increasing threats both from organisms and due to climatic stress.

This is a crucial area that urgently needs attention and resources.

Recommendations on emergent or invasive pests and diseases

Planning and monitoring

- 1) Baseline studies must be made of each invasive group to determine the extent of spread of each.

- 2) A full review of forest health and protection procedures must be undertaken, especially because of the reliance on a single species: Sitka spruce.
- 3) Action plans based on expert advice should be developed.
- 4) An expert specialist group to give advice, design training and ensure cooperation between different agencies.
- 5) Monitoring and immediate action for emergent or invasive diseases and pests. Detection, delimitation, control and/or eradication should be undertaken immediately by the authorities.
- 6) The Forest Service should report publicly on any new plant disease or pest immediately, to make people aware of what they can do to prevent its spread, and to access funds to clear the vector or alternative hosts.
- 7) Monitoring must be focussed and on a local or regional basis. This needs back-up of a specialist lab for diagnosis.

Training and advice

- 8) Foresters should be trained in monitoring forest health, how forests function, and the influence of stress. They should be able to correctly identify common diseases and pests, and isolate and sample for new or contagious elements.

Public information and awareness-raising

- 9) Public information is needed on how to prevent the spread of disease through simple sanitising of boots and equipment.
- 10) Awareness needs to be generated among contractors, ecologists, and other professionals about the serious threats of invasive and emergent pests. Accurate and up-to-date

reporting by the Forest Service is a crucial element of this public information campaign.

Forest management

- 11) Silvicultural treatments should be applied now to enhance resistance to future problems as well as resilience (recovery). This can be brought about by increased use of non-clearfell systems to enhance resistance and resilience. (See Section 3.3.4.1)
- 12) We recommend early thinning to increase stability and/or silvicultural systems that are more wind resistant as part of a wider forest policy review. Diversification of the age structure will also increase resistance in the face of emerging diseases or pests.
- 13) A variety of species and provenances should be used to protect from future shocks as well as permit choice of species and provenances performing better on each site as the climate changes. Poorly performing individuals can be thinned out later.
- 14) Incorporate non-clearfell systems to reduce incidence of pine weevil infestation.
- 15) Research needed to be conducted on invasives and biodiversity in the context of climate change (see Section 3.6.5)

Finance

- 16) Since invasive pests and diseases could threaten the entire forest estate, it is prudent to fund the above recommendations from the public exchequer or, alternatively, by forest owners paying a levy (for example, €1/ha/year).

3.3.5.2 Invasive plants

Invasive plants are becoming more common in Ireland. Some are garden escapes, while others are unintended introductions. Red-osier dogwood from North America has been planted extensively along new roads and is greatly

impacting wet forest habitats. The main invasive plants which affect forests and forest edge habitats are:

- Rhododendron (*Rhododendron ponticum*)
- Cherry laurel (*Prunus laurocerasus*)
- Japanese knotweed (*Fallopia japonica*)
- Red-osier dogwood (*Cornus sericea*)
- Traveller's-joy (*Clematis vitalba*)
- Spanish bluebell (*Hyacinthoides hispanica*)
- Montbretia (*Crocasmia x crocosmiiflora*)

Some other garden plants often spread into forests but do not spread profusely and so may not become major threats: Buddleia, *Lonicera nitida*, cotoneasters, giant hogweed, and Himalayan honeysuckle are examples. New invasives are found regularly, such as Skunk cabbage (*Lysichiton americanum*) found in Galway⁵². Some invasive species, including *Rhododendron ponticum* and lodgepole pine, regenerate on open habitats such as bog and heath, thus threatening their ecological integrity.

The main problem with invasive plants is that they replace a native plant in a particular niche, outcompeting native species. Invasives which become dominant give the most cause for concern. Some climbers will cover a plant, preventing its full access to light, or prevent regeneration of native, or otherwise desired, understorey or tree species. Some successful trees, such as sycamore, are tolerant of shade and regenerate under canopy, while their crowns produce dense shade, preventing further growth by saplings of other tree species or indeed forest ground flora. Red-osier dogwood can dominate the shrub layer in wet woodlands. The complex interrelated nature of an ecosystem means that an invasive plant species may exclude native animals, fungi, or lichens, from a forest. The impact of loss of biodiversity can be profound.

Recommendations on invasive plants

- 1) A coherent plan to deal with invasive species needs to be developed and implemented urgently by all the responsible agencies. A strategic approach is needed to assess the potential impact of threats.
- 2) Certain invasive plant species should be monitored and action taken if they threaten to degrade semi-natural habitats (e.g. Lodgepole pine on peatlands).
- 3) There should be concerted action on invasive plants without delay, including cessation of sales and new planting, and invasives should be removed where already present.
- 4) Public education is vital. Invasive species are often sold in garden centres and planted in ignorance of their potential impact on nature. Public education should include how to dispose of invasive plants, and this should be supported by incentives.
- 5) Education of, and cooperation with, horticulturalists and horticultural training centres should be put in place to ensure that invasive species are not sold or are sold with specific management guidelines
- 6) Training should be available for gardeners, landscapers, farmers, and forestry professionals on cleaning boots, equipment and wheels, removing seeds and regenerative pieces of invasive plants, and the potential seed bank in topsoil which may be translocated.
- 7) Foresters should be trained to identify native and non-native forest plants for ongoing monitoring and identification of problem areas (This could be part of the CPD programme; see Section 3.5.5).

⁵² Fallon, pers. comm.

3.3.5.3 Mammals

3.3.5.3.1 Deer

Four species of deer exist in Ireland: red deer, Sika deer from Japan, fallow deer and muntjac. The population centres vary, and each species has a slightly different role in the Irish landscape. However, all deer, depending on their numbers, can affect the forest structure, especially regeneration of trees and vitality of the forest understorey. Forest areas with large deer populations are unbalanced from an ecological point of view: the canopy is present but there is a noted absence of lower layers that belong in a forest. The presence of deer has also been shown to reduce the diversity of plants in the forest herb layer. Deer also browse trees, and they have preferences for certain species, although studies have shown that deer browse even the hard-needed Sitka spruce. Some trees can recover from browsing better than others. In the long term, over-population of deer can create impoverished, sparse and uncommercial forests.

The only native species of deer still present in is the red deer and there are no natural predators of deer present in Ireland. It is unlikely that natural predators such as wolves will be reintroduced into Ireland in the foreseeable future. Deer population control by stalkers and foresters has to date generally not been effective in reducing damage by deer to forests. This is due to recreational hunters and stalking managers wishing to maintain high deer numbers, the lack of co-operation between landowners who have deer on their land and a lack of landscape scale strategic deer management plans. The fear of a negative public response to a proposal to cull large numbers of deer may also be a factor why some policy makers are unwilling to tackle this issue.

Muntjac deer were until recent times unknown in Ireland but have been reported from Wicklow, Wexford and also in Northern Ireland. This is of particular concern as the muntjac has already been shown to have a high impact on

biodiversity in native woodland in England, it has the capacity to colonise new areas very rapidly and that humans have been involved in its illegal transportation and release into the Irish countryside. In Britain, Muntjac were first introduced from China to Woburn Park in Bedfordshire, England in the early 20th century. Their rapid spread in England and Wales has been facilitated by deliberate movement and release by humans. Muntjac are capable of breeding at the age of 8 months, and they breed all year round. The doe is quickly back in season and is usually served within 24 to 36 hours after giving birth and so the cycle begins again, statistically producing 1.5 offspring per year. This has also contributed to their rapid expansion.

In Britain, Muntjac deer populations have been shown to strip young trees and coppice of bark and leaves, destroying ground and field layers of woodlands and stopping regeneration. They are also known to eat wild flowers such as bluebells and to completely ring-bark older trees and there are concerns about potential major impacts on woodland biodiversity.

They have no statutory closed season in Britain. It is now illegal in Britain (Schedule 9 of the Wildlife and Countryside Act 1981) to release Muntjac into the wild except in what are considered its ten core counties in southern England.

Also of concern is the presence of Sika deer in the vicinity of native red deer as these two species can and do interbreed, threatening the genetic integrity of our native red herds.

Recommendations on controlling the threat from deer

- 1) A collaborative and integrated strategy to control deer populations should be coordinated by the National Parks and Wildlife Service.
 - Culling should be planned by a professional working group and carried out by professional hunters. The first

step would be to carry out a population count, followed by culling.

- 2) Seek to eliminate Sika deer where they occur in the presence of native red deer, such as in Killarney National Park.
- 3) Implement a campaign to eliminate the Muntjac before it becomes established over a wide area and impacts on biodiversity.
 - Survey to establish extent of spread on Muntjac deer.
 - Remove the close season on Muntjac.
- 4) Carry out an investigation to try and establish how Muntjac were introduced into Ireland, and by whom and prosecute the individuals concerned.
 - Even if the investigation itself were unsuccessful, there would be an important message to be broadcast about the illegality and potential dangers of introduction of alien invasive species.
- 5) Venison is a delicacy in many parts of Europe. There should be support for processing and marketing of venison at craft and at a larger scale.
- 6) The public need to be encouraged to accept deer management strategies, including the awareness of the absence of predators and the threats to forest ecosystems.

3.3.5.3.2 Grey Squirrels

The grey squirrel (*Sciurus carolinensis*) was introduced into Ireland in Castle Forbes, Co Longford in 1911. Since then it has expanded its range to 26 of the 32 counties on the island of Ireland. The River Shannon is frequently cited as a natural barrier to the grey squirrel's expansion. However, an invasive species typically spreads by the development of islands of new colonies beyond a colonising front. The grey squirrel may well become established across the Shannon soon, since it has expanded its range towards the river's source in County

Leitrim, and there have been sightings west of the Shannon. There also seems to be circumstantial evidence that the pine marten (*Martes martes*) may have an influence on the population dynamics of grey squirrels.

The grey squirrel causes significant economic damage to broadleaf stands in Ireland, particularly thin-barked species such as sycamore and beech. Significant damage may occur when young grey squirrel densities exceed 0.5 grey squirrels per hectare in spring and summer, when sap flow occurs. In Great Britain, tree damage has been observed on almost all species including Sitka spruce and other conifers. The damage is to timber quality, as well as tree stress and exposure to pathogens.

Grey squirrels also affect other biodiversity, such as populations of forest birds through predation of eggs and chicks. There is also growing evidence that grey squirrels are responsible for the decline and disappearance of the European red squirrel (*Sciurus vulgaris*) through competitive exclusion, and possibly through transmission of a virus.

Red squirrels can survive better in stands of small-seeded trees such as conifers. However, in Britain, grey squirrels can be found in pure conifer stands as well as other forest types, and it is unlikely that conifer refuges can support viable red squirrel populations without active intervention to maintain these areas free of grey squirrels, as well as sympathetic habitat management to reduce fragmentation and maintain feeding areas. Various control measures can be taken against grey squirrels including shooting, cage trapping and the use of poison. Issues of discriminating between the 'greys' and the 'reds' arise. Shooting is generally considered to be the least effective method. Warfarin is effective in Britain but is not suitable for use in areas where red squirrels or pine martens are present so is therefore unsuitable for use in Ireland. Cage trapping can be a very effective method when best practice is adopted, but it can be expensive. Dead

trapping is indiscriminate and should not be used.

Research into immunocontraception in a range of pest species has been carried out in various countries. However, further research will be required before an immunocontraceptive for grey squirrels can be used in practice.

The emphasis of Irish forestry policy has been on establishing a forest resource, focused on creation of fast-growing plantations of monocultures. It is desirable to increase the proportion of planting of broadleaves, particularly native species. The presence of grey squirrels is a very grave threat to the achievement of this aim. Furthermore, grey squirrels threaten the existence of red squirrels in Ireland in the long term, with the possible exception of island populations and defendable 'terrestrial island' populations.

Grey Squirrel colonisation

The 2007 squirrel survey may give an indication of where efforts should be concentrated: the survey map shows a classic moving front of invasive species, in which dispersers go out and colonise new areas. The pioneers may die or move further forward, but the ultimate result is that small groups of the invading species survive and spread to make a new moving front. The focus of the control should be on nodes to prevent the front from moving forward.

Recommendations on controlling grey squirrel

- 1) The National Parks and Wildlife Service, in conjunction with the Department of Environment Northern Ireland, should coordinate a grey squirrel management strategy for the island of Ireland to limit further expansion, to attempt to reduce its present range and to target control in high-risk areas and areas of high grey squirrel densities. This may include enhancement of pine marten habitats and examination for the potential for re-release of pine martens in grey squirrel areas.

- 2) Identify 'island' red squirrel reserves which can be defended from grey squirrel colonisation, as part of a red squirrel conservation strategy.
- 3) The presence of foresters, ecologists and land owners on the ground should be used to continue the on-going recording of grey squirrel presence. We recommend creating a method of surveying for foresters.
- 4) Additional research is required into:
 - the relationship between the two squirrel species and the pine marten.
 - the impact of grey squirrel on biodiversity.
 - population control and habitat management for both species of squirrels.
 - immunocontraception, in collaboration with other countries.

Heritage benefits

Protecting Irish forests from the effects of future climate change and other threats is crucial to their continued presence in the landscape, with all the related benefits.



3.4 Making forests work for owners

The long-term viability of our forests depends on their protection from attacks by pests and diseases, mammal damage, climate change, and possible uncontrolled cutting for firewood. It is also clear that forests also have to be economically profitable and sustainable for the owner. While non-market functions such as recreation, soil creation, hydrology, conservation, and visual aesthetics should be supported by public subsidy, forest products may also be a source of direct benefit or income to the owner.

3.4.1 Progress to date

The development of a new market, wood energy, has been a result of good policy-driven incentives and extension by a number of state agencies such as Sustainable Energy Ireland, COFORD and the Forest Service. The development of this market is directly correlated to the rise in prices for small diameter roundwood which in turn has made first thinning operations profitable. This has been timely as there are now large areas of privately owned forests at or approaching first thinning stage. In tandem with this, there has been much discussion and now some development, largely through Teagasc and the Forest Service, with regard to forming local co-operatives in forest ownership and timber production. Forest owner groups such as the IFA Farm Forestry Section and the Irish Timber Growers Association continue to represent their members and the ever growing private ownership of forests in sectoral forums. The development of certification in Ireland has reflected an increasing commitment to the principles and reality of sustainable forest management.

3.4.2 Income and markets

Most afforestation is carried out by farmers, who need to receive an income from their forests once annual premium payments cease. Other forest owners will

also benefit from improved market returns, whether they have received premiums or not. Much of this income is expected to come from the sale of forest products, such as timber and possibly non-wood products. Some income may come from other forest related functions and services. Not all forests should be managed for timber production; some will be managed solely for non-timber objectives, or retained with minimum intervention.

Proper management of a forest from which timber will be produced will help increase returns; e.g. timely thinnings (see Section 3.3.3). The wood energy market has developed rapidly, partly thanks to proactive policy development and market incentives. Thinnings can be sold locally for energy and at relatively high prices. This has been a welcome development. Some product harvesting may be for direct use, such as the proposed development of home-grown renewable wood fuel (see Section 3.1.6). Direct use should be included in the management plan and not exceed sustainable yield.

Markets for Irish softwoods are fairly well-developed, and it is now time to develop a broadleaf timber industry, including quality primary and secondary processing (see Section 3.1.5). Private landowners may be more encouraged to plant and properly manage broadleaves if it can be demonstrated that an income can be generated throughout the rotation. Markets for small-diameter broadleaf timber need to be investigated, and methods of direct access for fuel also developed.

Timber production forecasting requires information on forest management objectives and planning, and therefore must be integrated into specific forest inventories and management plans prepared by foresters in consultation with owners (see Section 3.3.2). The silvicultural system selected will also influence timber quality and regularity of supply (see 3.3.4).

Markets and transport are important aspects of production. It is appropriate in these times of rising fuel prices to

concentrate production and market initiatives on locally-grown timber. In addition to reducing transport costs, value could be added locally, and wood processing could become a rural development activity. Irish people consume large amounts of timber, and there is ample room for development of wood-based industries. Local production could be used as a marketing tool, as it is with some food products. Irish consumers may wish to choose local timber, especially for uses such as hurleys.

Recommendations on markets

- 1) The National Forest Inventory now needs to be further developed to embrace a national timber production forecast and comprehensive spatial information on species, age, location and yield class to inform forest industry decisions and investment. A tree species selection strategy can then be developed, based on potential future markets and other factors such as site suitability.
- 2) An agency should be created to promote minor species and broadleaves, with a remit for market development and research, branding, marketing and timber product development.
- 3) Local markets should be developed for fuel and added-value timber. Development of source-identified schemes will help consumers become aware of the distance their timber of fuel has to be transported, and to select locally produced wood.
- 4) Markets for small-diameter broadleaf timber need to be investigated to enable farmers to receive an income once the annual premium payments cease. By demonstrating that an income can be generated throughout the rotation, private landowners may be more inclined to plant and properly manage broadleaves. (See Section 3.1.5).

Heritage benefits

Development of varied local market of quality forest products will encourage use

of a renewable natural resource with minimum transport costs and a secure income for forest owners.

3.4.3 Certification

The use of quality standards is one way in which good forest management can be encouraged. Forest certification is a quality standard designed to send a market signal to buyers that the products they purchase are derived from forests managed to particular environmental and social standards. There are several international and national standards in use across the globe. The standard currently being used in Ireland is the Forest Stewardship Council (FSC). Other schemes include the Programme for the Endorsement of Forest Certification Schemes (PEFC) and North American systems such as Sustainable Forestry Initiative (SFI).

There are two levels of SFM standards:

- 1) The national standard, as derived from the Helsinki Process, and
- 2) The additional standard used to provide independent verification in the market.

Currently, the Forest Service has a published standard based on the Helsinki Process, but this is a general explanation of the principles of SFM. The fundamental principles are set down in the Helsinki Process, but forests vary enormously between the signatory nations, e.g., Ireland, as described in Section 1, has far more exotic plantations than most other countries in Europe. Certification standards set out the practical details of sustainable forest management in the regional context and on a practical level. The Forest Service should develop a generic and practical standard for forest owners in Ireland.

The Forest Service is well placed to drive certification now that Ireland has signed up to the principles of sustainable forest management (SFM). As part of the development of an up-to-date forestry policy, strengthening of the Forest Service standard will help ensure that all Ireland's forests are managed to high standards. This should make it straightforward for those who wish to submit their forests to independent certification.

The second level of SFM standard is the voluntary certification schemes, through which a forest owner can receive independent verification of sustainable management. Each certificate is subject to periodic review and reassessment in recognition of the evolving nature of forest management. These audits compare the management on the ground with detailed criteria as set out by each specific standard-developing body (i.e. FSC, PEFC). For this case, a national (or regional, in the case of large countries) standard must be written which hones the general criteria for use in the national context.

The process of developing an FSC-approved forest certification standard for Ireland began in early 1999 when the Irish Forest Certification Initiative (IFCI) was set up. The IFCI was accredited by the FSC in 2006. The IFCI is preparing and receiving submissions on a national draft standard. The lack of progress in developing a national standard is unsatisfactory. Although three forest enterprises in Ireland are currently certified and audited against a generic standard, a nationally-specific standard is more appropriate and would make the audits more specific to Irish conditions.

Currently, most of the certified timber in Ireland is produced by Coillte. One of the main advantages for the company has been to allow its customers to access broader markets where certified timber is a requirement (e.g. UK). Also, certification has improved Coillte's forest practice and has helped in the setting up of a framework for public consultation on forest management.

There has been little demand for certification of private forests so far. This situation is likely to change with the increasing production of privately owned timber. However, little has been done to develop awareness in the private sector about the requirements and advantages of certification. Also, the nature of the private estate (i.e. scattered, small-scale) needs to be considered when looking at the potential for certification for private forest owners via group certification.

Ireland also imports a large volume of timber, much of it from West Africa (see Table 2, section 3.1.4). Procurement policies ought to support responsible use of resources in other countries as well as at home. For example the EU Action Plan for Forest Law Enforcement, Governance and Trade project is expected to lead to a timber import licensing scheme between timber importers and exporters and eventually encourage certification in tropical hardwood producing countries.

Certification as a market standard depends on the demand by the consumer. This demand was the original motivation for the company policy adopted by B&Q, which in turn was a main factor in Coillte submitting to an audit and maintaining the certificate. The public should be informed about certification and encouraged to make a consumer's choice.

A legally binding standard for growers

All forests would be compliant with international standards, and those who wish, may take the extra step of being assessed on the quality of their forest management on a specific label, such as the FSC, the PEFC, or another. This may be similar to the English forest grant scheme, which is FSC-compliant. Fulfilling this scheme's requirements makes it simple for owners to take one more step to become certified under a voluntary scheme with a related quality symbol. The Forest Service can facilitate the development of the scheme and ensure involvement of stakeholders. All additional documents and data such as the management plan template (see Section 3.3.2) would comply with the national certification standard and a specific certification body

Recommendations on certification

- 1) Growers should be subject to legal requirements to manage to a certain standard, as in Austria. In this manner, all forests would be compliant with international standards, and those who wish, may take the extra step of being assessed on the quality of their forest management on a specific label, such as the FSC, the PEFC, or another.
- 2) The Forest Service should encourage the completion of a properly developed and endorsed national standard for the second level (independently audited standard).
- 3) Certification among small forest owners should be encouraged by exploring the possibility of group certification schemes and adaptation of the standard for small-scale forest owners (e.g. SLIMF initiative in UK)
- 4) Training programmes should be initiated to improve awareness and skills of forest owners and managers to the requirements of certification
- 5) Information should be made available to consumers about choosing certified products and about how certification can help one ensure one is not purchasing illegally logged imports.
- 6) Government bodies need to ensure that imported timber does not come from illegal sources. A requirement for FSC certification may be a means of ensuring that timber comes from sustainably managed forests.
- 7) An information pack describing and giving guidance on both levels of certification should be freely available and downloadable from the Forest Service (see Section 3.5.2).

Heritage benefits

Wider adoption of FSC certification will allow Irish consumers to independently verify that the wood they are purchasing has been grown to high environmental, social and economic standards. Irish forest management will continue to improve over time as the standards evolve and as forests are re-inspected.

3.4.4 Coillte as a special owner

Coillte Teoranta, the Irish Forestry Board, was established as a semi state company in 1988, under the Forestry Act, 1988..

The statutory objects of Coillte are defined in the Act:

- To carry on the business of forestry and related activities on a commercial basis and in accordance with efficient silvicultural practice
- To establish and carry on forest industries
- To participate with others in forestry and related activities consistent with its objectives, designed to enhance the profitable operation of the company
- To utilise and manage the resources available to it in a manner consistent with the above objects

The statutory general duties of Coillte, as defined in Section 13 of the act, are:

- To conduct its affairs so as to ensure that revenues of the company are not less than sufficient to:
 - Meet all charges properly chargeable to revenue account (including depreciation of assets and proper allocation to general reserve) taking one year with another
 - Generate a reasonable proportion of capital needs
 - Remunerate capital and repay borrowings
- To conduct its business at all times in a cost effective and efficient manner
- To have due regard to the environmental and amenity consequences of its operations
- To provide for consultation with the Minister for Finance concerning forestry development in areas of scientific interest

Coillte was primarily set up to manage the national forest estate on a commercial basis. Much of its current assets were acquired previously with taxpayers money and therefore public concern in how the company operates is valid. Many of the State forests deemed to be of value for biodiversity were not transferred to Coillte but to the NPWS. The provisions in the

Forestry Act, 1988, reflect the economic state of the country in the late 1980s. While Coillte has operated successfully to date within the statutory framework (see Figure 1), concern is often expressed that more attention should be paid to the non-timber products and services associated with the national forest estate inherited by Coillte (approx. 445,000 ha. of which approx. 350,000 ha. are forested). Indeed, in 2007, there is an entirely different value system associated with forestry and forest management — one which is not reflected in the 1988 Act.

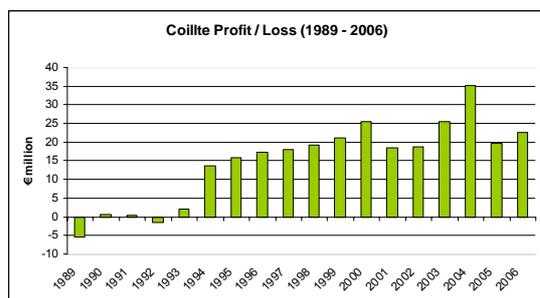


Figure 1: Coillte profit and loss since 1989.

The independent forest management certification process organised by the Forest Stewardship Council (FSC), in which Coillte is engaged, has independently verified that Coillte is managing its resource sustainably, to internationally accepted social, environmental and economic standards. The continued engagement of Coillte since 2000 in this process has been a welcome development and has transformed the way in which the company manages its resource and interacts with the public. While a thorough and objective analysis of public demands from forests is required (see Section 3.6.5 below), progress has clearly been made by Coillte in the last decade in the delivery of non-timber products and services. However, the delivery of these products and services is expensive and despite having significant value, they rarely generate substantial revenues. Coillte finances the delivery of these services through revenues generated from other profit centres within the company and through partnership with funding agencies such as Fáilte Ireland.

Coillte has also integrated into the panel board sector (Coillte owns Medite Europe Ltd. Smartply Europe Ltd.) in order to add profitability to the Coillte group. In recent years, non-timber product revenues have included land sales which, although not detailed in the annual reports, contribute significantly to Coillte's revenue. Figures reported by Coillte for 2004 and 2005 show that over 50% of revenues are derived from non-timber products and services, much of which is believed to come from the sale of land. Figure 2 shows the areas of land sold annually by Coillte from 2002 to 2006.

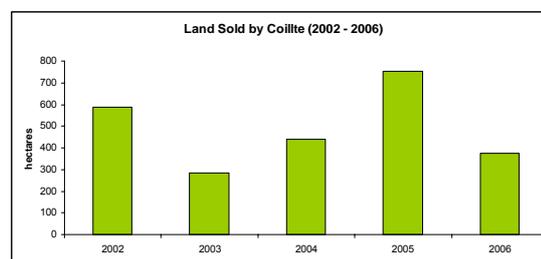


Figure 2: Area of land sold by Coillte, 2002-2006.

In consultation with the Minister, Coillte is entitled to sell land (as provided for in Section 14 of the Forestry Act, 1988) and in many instances there may be strong reasons for doing so. Indeed, Coillte engages in a public consultation process before any land is sold. The areas sold by Coillte represent a tiny proportion of the forest estate and in many cases are considered outlying and unprofitable. However, the reason for selling public land should not necessarily be in order to realise the higher value that this land may have, compared with the value for forestry. These areas may have other values which may be best protected and enhanced in State ownership.

This again raises the question of how forest land and associated products and services are valued. Coillte reports that the annual recreational value of its forests is €97 million and that this generates a further €268 million of economic activity in local communities. Further significant yet un-quantified values are associated with other services such as soil protection, water regulation, and biodiversity

enhancement. Coillte produces a regular social and environmental report which has benchmarked many important social and environmental indicators and its performance in relation to these. However, an objective, consistent and internationally accredited system for the valuation of non-timber products and services could be usefully employed by Coillte. This valuation system would demonstrate that the capital value of non-timber products and services is increasing, as well as isolating the value of various non-timber products and services for the purpose of seeking specific funding for the provision of these services.

It is clear that timber and timber product revenues alone are not sufficient to fund the current and capital requirements of Coillte's business. However, it is not clear to what extent the provision of non-timber products and services is subsidised or what the value of these services is. In certain cases, Coillte has proved that it can deliver these services to a high standard where appropriate funding is obtained e.g. Fáilte Ireland funding of development and upgrading of recreational facilities. It is worth considering how these kinds of services could be provided throughout the country if funding were available. While the sale of land as a source of revenue is understandable given Coillte's statutory objectives and commitments with regard to FSC certification and general good stewardship of the State forest resource, it is not entirely satisfactory, since it involves the depletion of this resource, particularly at local level, where the impact may be significant.

Provision is made in the Forestry Act, 1988 (Section 38), for the Minister to issue directions to Coillte to:

- Comply with policy decisions of a general kind made by the Government concerning the development of forestry and related activities of which he may advise the company from time to time, or
- Provide or maintain specified services or facilities, or

- Maintain or use specified land or premises in the company's possession for a particular purpose. Coillte is obliged to comply with such directions but if it can satisfy the Minister that it has sustained a loss in doing so, it is entitled to recover the loss from the Minister. It is therefore clearly within the Minister's brief, if (s)he chooses, to fund the delivery of unprofitable yet valuable goods and services by Coillte. Alternatively, the funding of such services could continue to be sourced externally from bodies such as Fáilte Ireland, the Health Service Executive, local authorities, EU Programmes (e.g. EU Life Nature Programme), National Lottery, and private sponsorship (e.g. Millennium Forests). However, the first step must be to use an objective, consistent and internationally accredited system for the valuation of non-timber products and services and report on this annually.

Recommendations on Coillte

- 1) Coillte, in consultation with the Minister and forestry stakeholders, should develop an objective, consistent and internationally accredited system for the valuation of non-timber products and services and report on this annually. The report should, as far as is possible, break down the values of different products and services and identify the beneficiaries of such services in order to facilitate the appropriate funding of these services.
- 2) Coillte, in consultation with the Minister, should develop a strategy for the funding of non-timber products and services which delivers value for money to the funding organisation, whichever this may be.
- 3) The Minister should take an active role in representing the best interests of the Irish people with regard to the sale of State land by Coillte.
- 4) The board of Coillte should include a broader base of independent professional expertise particularly

relating to forestry and the environment.

- 5) While the sale of land may be appropriate in some cases, the sale of land solely for the purpose of generating income should be subject to a rigorous assessment of the full value of the land to the public, including the non-market values associated with it.
- 6) Revenues generated from land sales should be clearly and unambiguously reported in Coillte's annual statement of accounts.

Heritage benefits

Isolating the value of non-timber functions of State forests will allow a true valuation of those important services. Furthermore, this process will allow for an annual assessment of how the value of non-timber services changes with current forest management practice. This approach will raise the status of enhancement of heritage values within the management policy of the national forest estate.



3.5 Legislation and authorities

3.5.1 Progress to date

After its foundation in 1904, Irish forestry first developed slowly. However, it gathered pace during the 1950s and has developed rapidly since the mid-1980s. Ireland's forestry authority is the Forest Service, which is currently part of the Department of Agriculture, Fisheries and Food. The Forest Service has taken the lead in developing guidelines for the implementation of Sustainable Forest Management. The Forest Service has also overseen a variety of incentive schemes, most recently those reflecting the importance of forestry in environmental as well as social and economic terms.

3.5.2 The governance of forestry

The Forest Service in the Department of Agriculture, Fisheries and Food is currently responsible for the governance of forestry in Ireland. It is responsible for ensuring the development of forestry in a manner and to a scale that maximises its contribution to national socio-economic well-being on a sustainable basis that is compatible with the protection of the environment. Its strategic objectives, as stated on the Forest Service website, are to:

- To foster the efficient and sustainable development of forestry.
- To increase quality planting.
- To promote the planting of diverse species.
- To improve the level of farmer participation in forestry.
- To promote research and training in the sector.
- To encourage increased employment in the sector.

These strategic objectives are supplemented by the many sub-sectoral policies and strategic actions outlined in *Growing for the Future: A Strategic Plan for the Development of the Forestry Sector in Ireland*. This policy was published in 1996 and sought to develop the industry to a critical mass whereby 17% of the land

area of Ireland is forested with an annual output of 10 million m³ of timber by 2030. While the Strategic Plan is still the primary policy document for the development of forestry in Ireland, it should not be viewed in isolation, since policy and practice have continuously evolved in response to changes in both national and international priorities and legislation. Many of these policy developments have been positive for the protection and enhancement of the national heritage. Some of these policy developments have been:

- The Irish National Forest Standard (2000)
- The Code of Best Forest Practice (2000)
- The suite of Guidelines on Water Quality, Archaeology, Landscape, Harvesting, Biodiversity, Aerial Fertilisation, Forest Protection and Forest Recreation
- The protocol for determination of acid sensitivity of surface water in the context of afforestation (2002)
- The Forestry Schemes Manual, last updated in 2003
- The development of procedures for environmental protection and consultation controls process (incorporating the Forest Consent System)
- The design and development of a national GIS database (Indicative Forest Strategy, or IFS)
- The Native Woodland Scheme and associated guidance notes
- Completion of the Forest Soil Survey (2007)
- Agreement with National Parks and Wildlife Service on a management protocol for forestry in hen harrier Special Protection Areas (SPAs; 2007)
- Completion of and publication of results from the National Forest Inventory (2007)
- Forest Environmental Protection Scheme (FEPS; 2007)
- Publication of numerous COFORD-funded research project results

Such policy developments are generally communicated well to those active within the forestry sector. However, there is an absence of and a need for a single policy

document, in the manner of *Growing for the Future*, which joins up all the sub-sectoral policy developments and which clearly communicates to those inside and outside the forestry community the vision for forestry in the future and the short-medium- and long-term policies that will lead to the realisation of that vision. This is clearly needed, since one of the principal objectives of the 1996 plan — ambitious planting targets — has not been achieved and “critical mass”, defined in the plan and one of its cornerstones, is some distance off course. Indeed, since its publication, events have overtaken the plan’s relevance in many areas and some critically important new issues have developed, such as wood energy, carbon sequestration and certification, which are not dealt with in any detail in the plan.

Central to the development of a new strategic plan for forestry must be a properly conducted debate on what is required and desired of our forests, both now and in the future. Within the forestry sector and related environmental and land use sectors, there is reasonably good, if sometimes embittered, engagement with regard to policy development and regulation. However, there is relatively little understanding of or engagement with the general public on forestry issues.

Another important requirement is for a Forest Service annual report on the performance of the sector against a range of performance indicators. An annual report was produced by the Forest Service up until the formation of Coillte in 1988, but not since. Such reports are commonplace in most developed countries and provide useful statistics and guidance for those within and outside the forestry sector. Performance indicators should be representative of the broad social, environmental and economic functions of forests and should, if consistently applied, provide useful measurements of the delivery of products and services from the public and private sector combined. The welcome development of the National Forest Inventory will help in this regard. Performance indicators are considered below.

The Forest Service has experienced eight departmental transfers since the foundation of the State. Five of these transfers have taken place in the last 35 years, a typical rotation length for a conifer crop. This has quite serious implications with regard to the retention of corporate memory in an industry that requires long term policies and strategies. The lack of a long-term home for the Forest Service indicates a level of confusion about the role of forests and their benefits to owners, society and the environment. By its nature, forestry requires a long term planning horizon with consistency in policy, sustained investment and corporate memory that transcends the lifespan of governments. The Forest Service is organised around a civil service dual structure and, while it has withstood the test of time, it is poorly suited for the ongoing needs of the sector and lacks the flexibility to deliver the level of service now required.

There is a need to clearly separate the leadership role of the Forest Service, which requires strategic planning and policy development, from the day-to-day grant and premium administration and regulation of the sector. This would be best achieved through the re-organisation of the Forest Service into two separate agencies with their own clear organisational structures and technical and administrative staff, as proposed below.

The Forestry Sector Development Agency would have a clear mandate to lead the sector and to develop policies and strategies e.g. a National Hardwood Strategy (see Section 3.1.5), a Native Woodland Strategy, a Timber Marketing Strategy, etc. It would also oversee policy with regard to training and research and take charge of the National Forest Inventory. In addition, units should be created within the Development Agency to cater for the specialist knowledge required for proper analysis and management for the different functions of forestry. Specialist units should include more than one person and expand on the developments already begun with appointment of individuals: ecology, archaeology, recreation and consultation.

The Forestry Administrative and Regulatory Agency, independent of the Department of Agriculture, Fisheries and Food, that would have a clear mandate to administer the grant and premium schemes and to regulate the sector e.g. licensed foresters, forest health, sustainable forest management etc. These programmes should have multi-annual budgets and be protected from the disruption which badly damages confidence in the future of forestry.

Recommendations on forestry governance and legislation

Policy

- 1) A national forest policy is needed, with specific goals for defined short- and medium-term periods, as well as guiding policies for the long term.
- 2) The new national forest policy must integrate the various measures for different sub-sectors to ensure there is coherent and effective policy for the long term.
- 3) An annual report should be published by the Forest Service which, inter alia, measures the performance of the sector against a range of performance indicators (see Section 3.5.3).

Administration

- 4) The Forest Service should be re-organised into two separate agencies, namely: a Forestry Sector

Development Agency, and a Forestry Administrative and Regulatory Agency, both with their own clear organisational structures and technical and administrative staff.

- Structures should be put in place to maximise the synergy between the various forestry organisations.
- 5) These agencies should employ specialist staff to deal with biodiversity, archaeology and recreation, who will provide clear guidelines for the area Inspectors (see Sections 3.2.4). There needs to be increased input from ecologists both at a policy and field level.
 - 6) Until the proposed re-organisation of the Forest Service is complete, it should employ additional ecological staff.
 - 7) The proposed Forestry Development Authority should cooperate with COFORD to identify research needs.

Amendments to legislation

- 8) The review of the Forestry Act, 1946, needs to be completed. It must incorporate the principles of sustainable forest management.
- 9) The obligation to replant following felling should be removed and replaced with a more mature system whereby sites can be restored to sustainable land uses for sound reasons.
- 10) The felling license system, regulated by the Forestry Act, 1946, needs to be overhauled, as follows:
 - A license should not be required for thinning, except in sensitive areas.
 - There should be more emphasis in licensing foresters to carry out best practice, with associated penalties for irresponsible practice, rather than creating a barrier to thinning.
 - All harvesting should be planned properly in a management plan prepared by a licensed forester.

- 11) With the exception of the Recreation Guidelines, the existing Forest Service guidelines should be presented as regulations.

Grants and schemes

- 12) The stop / start nature of schemes, such as NWS and Woodland Improvement Scheme, should be avoided. Multi-annual budgets should be prepared for defined periods with long lead-in planning timelines prior to subsequent periods.
- 13) Mechanisms should be implemented to improve the uptake of FEPS, NWS, and afforestation schemes, including promotion on the ground and improved administration.
- 14) Forestry grant and premium rates should track inflation, and a scheme should be considered whereby remuneration is available to forest owners who provide facilities for public access to their forests.

Benefits to heritage

The formal articulation of the developments in Irish forestry in a single new forestry strategy would help to underpin the positive developments that have occurred since 1996 and would knit together the important sub-sectoral but related heritage issues in a single, balanced policy document accessible to those within and outside of the sector. The production of an annual Forest Service report will provide clear and consistent performance measurement against key indicators of sustainable forest management and the delivery of both timber and non-timber products and services, many with direct heritage implications. The separation of leadership and administrative / regulatory roles in the Forest Service will leave each unencumbered by the other and provide a greater focus on the development of policy on the one hand and the delivery of services on the other. A greater continuity in forest policy and its funding through the various schemes is essential if a forestry

culture is to be developed in Ireland. Such continuity will foster the development of expertise and careers in all areas of the wood chain, from seed collection to timber use.

3.5.3 Targets and indicators of performance

In recent years, the annual planting programme has fallen short of its (out-of-date) targets, raising concern within the sector. There is a strong lobby to increase planting levels, and annual planting statistics are currently used as the principal yardstick by which the success of the forestry sector and the Minister are measured. While the maintenance of a strong afforestation programme is important, there are many other aspects of the forestry sector which are developing positively such as the strong growth in timber prices, the wood energy sector and interest in native forests and hardwood production. The current emphasis on afforestation is partly due to private forest companies which have successfully developed a profitable business model in this sector, but the ways and means of providing a profitable service for later forest management have not yet been fully developed. It is important now, with the maturation of the private sector, that the Forest Service and the sector generally develop a wider range of performance indicators by which to measure performance (See Section 3.5.3 above). For example, when considering the drive towards increasing forest cover, the proportion of new plantings under native forest is an important indicator of multiple functions. Other examples of suitable benchmarks include: the quantity and quality of timber produced in the private sector, the amount of woody energy being produced, the quantity of non-timber forest products, production figures for different timber assortments and even professional benchmarks such as the CPD of licensed foresters. Such benchmarks can be reported in the proposed Forest Service annual report.

There is a considerable volume of work required in putting in place appropriate data collection methods and reporting structures for the compilation of such statistics, but once in place there will be a clear and concise annual insight into the forestry sector as a whole. The system of licensed foresters (see Section 3.5.5 on the forestry profession) should be used as the reporters on the ground that are required to feed raw data / information up the line on an annual basis through a standard reporting mechanism (see Section 3.3.2).

Recommendations on indicators of performance for Forest Service annual report

- 1) The content of the proposed annual report may include the following themes:
 - Areas of new policy development
 - Afforestation statistics by species, species mixture, plantation size, objectives, and region / county
 - Timber:
 - Thinning statistics by age class, volume, species, area and region / county
 - Clearfell statistics by age class, volume, species, area and region / county
 - Harvest statistics for forests not under clearfell systems
 - Volume output from Irish forests and product flow chart by volume
 - Timber value output from Irish forests, specifying hardwood or softwood and degree of processing
 - Timber export statistics
 - Timber import statistics
 - Training statistics by course, recipient group and numbers.
 - Silvicultural system by area and region / county. (Thin, No-thin, Continuous Cover, Coppice, etc.)
 - Number and area of applications, approvals and grant payments per scheme (including non-grant schemes such as aerial fertilization)
 - Breakdown of expenditure per scheme

- Carbon sequestered by Irish forests (as measured for the Kyoto Agreement and for the Intergovernmental Panel on Climate Change (IPCC))
- Value of non-timber products and services: a consistent approach to that employed by Coillte (see Section 3.4.4) should be applied
- Area, type, and quality of non-forest habitats being maintained
- Areas managed or cleared of mammal threats such as deer and grey squirrel by region / county
- Areas cleared of invasive plants by region / country
- Areas monitored for forest health by region / county
 - Invasive or emergent pests found, method of addressing, and indication of success or lack thereof
- Types and locations of recreational development
- Types and basic themes of public consultation supported by Forest Service

Benefits to heritage

Emphasis on the performance and values of Irish forests will help the proposed wider focus on all the services that our forests provide.

3.5.5 Licensing foresters

Forestry is a profession ready to take on increased responsibility for good forest management. This could be facilitated by a licensing system with a required number of hours of continuing professional development (CPD) annually. Licensed foresters would prepare an entire operational plan, including consultation with all appropriate stakeholders, for grant aided operations and the Forest Service would monitor the quality of the foresters work, rather than each individual site. Each site where operations are grant aided would require a technical plan to be drawn up and implemented, along the lines of the plan required for the existing

Native Woodland Scheme (see Section 3.3.2 on management planning above).

Some of the newer grant schemes, such as the Forestry Environment Protection (Afforestation) Scheme (FEPS) and Native Woodland Scheme (NWS), provide a greater degree of flexibility for the use of minor species, alternative mixtures and silvicultural systems. The Forest Service should trust and empower foresters to make silvicultural decisions based on individual site opportunities and individual owner's objectives, taking into account factors relating to any given site situation, e.g. soils, scale of planting, potential local markets, landscape sensitivity, and habitat conservation.

Foresters have a valuable role in society as they are entrusted with the important responsibilities of managing forests sustainably and ensuring that a wide range of forest owners' objectives are achieved. In most cases, the forest management decisions and actions made by foresters affect not just the forest owner but the wider community and environment. Foresters are responsible for the planning and implementation of important operations including:

- forest establishment
- early crop maintenance
- development of access
- multi-resource forest inventory
- thinning and harvesting
- timber measurement
- crop improvement
- enhancement and delivery of non-timber products and services

All of these operations must be carried out within the sustainable forest management framework as outlined in the numerous Forest Service guidelines, codes and regulations associated with the various Forest Service schemes. They all require detailed technical knowledge, experience and planning and in some cases a multi-disciplinary approach. Furthermore, forestry companies may have their own internal operating systems and business processes which are followed by foresters.

The Forest Service operates an "Approved Forester" system which effectively licenses foresters to provide services relating to these schemes to the private sector. In effect, private sector foresters become agents of the Forest Service in selling and implementing contracts under the various schemes amongst their client base. This model has developed over time as a way of delivering the substantial investment made by the EU and the Irish government in Irish forestry.

There are difficulties associated with this system in relation to the forestry profession. Many foresters feel that they have become somewhat institutionalised or "dumbed down" by adopting a formulaic approach to forest establishment and management and can feel disconnected from forest management activity. Situations can arise where compliance with the rules of the schemes (e.g. choice of species mixtures, approach to forest improvement etc.) or company policy dominate the forester's decision-making on the ground instead of the specific site conditions that (s)he encounters. In many cases, it appears that the design of Forest Service schemes and associated rules are as much if not more associated with the ease of administration as the actual technical requirements on site. This can have a demoralising effect on a profession which should be leading the way in silvicultural practice and developing appropriate sustainable forest management systems for Ireland's new forests. It is understandable how this situation has developed, given the predominant focus on afforestation. However, as the forest estate matures, so must the policies and procedures associated with managing this new resource in the best interest of forest owners and the wider community. (Forest Management and Forest Management Planning are dealt with separately in Section 3.3) Foresters should be at the forefront of integrating forestry into the community, other land uses and other enterprises.

Foresters spend much time on site and are therefore an untapped resource as the

eyes of a refocused forest protection policy (see Section 3.3.5) which could be used in reporting invasive pests and diseases in forests throughout the country. This will be an area requiring increased vigilance, given the projections for global warming and its impacts on forestry in Ireland.

The Society of Irish Foresters, the professional body for foresters in Ireland, operates a continuous professional development (CPD) scheme. This is voluntary for members and, although highly worthy, is not yet working on a properly regulated basis.

It is suggested that a licensing system of foresters be implemented, allowing increased freedom for the forester, who will take responsibility for drawing up and implementing a management plan for new and existing forests. The Forest Service inspectors, who themselves should be licensed foresters, will subsequently inspect the quality of the foresters' work, rather than the getting caught up in the administration of specific grants.

Recommendations on licensing foresters

- 1) The Forest Service Approved Forester System should be developed into a Licensed Forester System. Foresters should be empowered to operate according to site-specific management plans drawn up and implemented by them in association with their clients.
- 2) The licensed forester should gain consent and consult with agencies and individuals on site. This will afford the forester an opportunity to improve or alter the plan.
- 3) The forester should produce and submit an agreed forest plan with all grant applications to the Forest Service. This plan should be more detailed than current Form 1 (see Section 3.3.2).

- 4) The voluntary Continuous Professional Development (CPD) scheme should be developed into a compulsory scheme for all licensed foresters. Administration should be funded by the Forest Service (see below for section 3.5.2 relating to training and education). Compulsory CPD schemes operated by other professions should be used as a model in this regard.
- 5) The Forest Service Forest Protection Unit should harness the private forest management resource and develop training and protocols to maximise forest protection measures in anticipation of climate change.

Benefits to heritage

The forester's role is central to the future delivery of multifunctional forests. It involves management planning and operations, with all the associated responsibilities for consultation, ecological safeguards and other aspects that this implies. The proposed re-design of the administrative system will allow correct decisions to be made for each site (e.g. species choice, species mix, thinning intensity and silvicultural system). This should also facilitate suitable silvicultural skills amongst foresters and will place them at the heart of the communities in which they work.

Adoption of this system will result in upskilling in the forestry profession, integrating professionals and a forest management culture into the community. A strong environmental benefit is expected, as more leeway and training will allow foresters to develop forests with a greater diversity of species, managed by a variety of techniques. Foresters will become stewards of an inherited, ecologically valuable, multi-functional natural resource.



3.6 Training, education, public engagement, and research

Many of recommendations in this review are dependent on a change in values in the forestry industry and among the public. A vibrant and forward-looking forestry sector will incorporate improvement of skills, new techniques and an expansion of the knowledge base. We can already see signs of change in this direction.

The further development of skills and knowledge in forestry will be gradual, as personnel and resources permit, and as the sector and wider society adjust to this fresh approach. This section points the way towards further progress.

3.6.1 Progress to date

Forestry is becoming a popular career choice, with three degree-level courses and several additional skills courses available in Ireland. Many working professionals have participated in additional training, such as certificate courses in biodiversity or GIS. Woodlands of Ireland and the Forest Service jointly hold training courses for the Native Woodland Scheme and for development of specific skills in subjects such as riparian woodland and soils. Muintir na Coille, the Coppice Association of Ireland, hold skills training courses in coppice management. COFORD, the EPA and the Western River Basin District are among the organisations that have funded research connected with forestry. Positive contact between land managers and the public is also increasing.

3.6.2 Education and training

Three third-level courses in forestry are offered. UCD has a four-year honours degree in forestry. Waterford Institute of Technology has a three-year course in forestry with an add-on year in business for an honours degree, and Galway Mayo Institute of Technology offers a three-year ordinary degree in Forest Management and the Environment, along with an

agreement with University of Ulster for a one year add-on to complete an extra honours degree in Environmental Science.

Related courses that are of benefit to Irish forestry are also available. For example, UCC offers a training course on biodiversity for foresters. Ballyhaise provides foundation training in forestry, and skills training for foresters and forest contractors is provided through several centres.

A majority of the recommendations made in the previous sections rely on an expansion of training. Many forestry-related skills need to be more fully developed, both among professionals and students. For example, there is an urgent need for training of foresters in forest health, and also of scientists who can give survey advice and diagnostic assistance. Ecological experience also needs to be further incorporated into forest resource planning. Practical, detailed guidelines and general courses are useful for professionals to understand general principles, such as managing for different aspects of biodiversity. Dissemination of research findings, both quantitative and qualitative, should underpin the training. Current knowledge derived from research should be incorporated into all forestry education modules and be used to update teaching content, leading to well-educated professionals in sustainable forest management.

In order to implement truly multifunctional forest management, foresters and other forest workers and planners need to be trained in a multitude of skills and analytical approaches. Education and training of foresters should address the forest as a whole. In addition, the number of ecologists and environmental scientists specialising in forests and forestry, and directly employed in the forestry sector, should be expanded.

Forest contractors and owners would also benefit from additional knowledge and skills. Training of forest contractors could involve a designed career path and apprenticeships. Implementation of the

proposed expanded Landscape Strategy would involve training for Heritage and Biodiversity Officers, other local authority staff, and land use advisors. Others involved with forestry could benefit from training in forest management of particular types of sites. Examples are training planners and local authority staff on in designing urban forests and ecological corridors, educating REPS planners on the different forestry incentive scheme suitable for the different objectives a landowner may have, and Native Woodland Scheme ecologists on identifying open habitats which should be retained. Forest owners will be better able to plan and manage their forests if they know more about multifunctional forest management, timber quality management (e.g. thinning), the impact and management of using the forest for grazing and winter shelter for stock, and protection and management options for privately-owned native forests.

The proposed licenced forester scheme described in Section 3.5.5 above will require provision of continuing professional development (CPD) modules. These modules should be rigorous and objective-oriented. Field days may be of use, as long as the days include focussed discussion and instruction aiming to bring new information and skills to the professional audience. Some training will be primarily informative and can be completed in single-day modules, while skills development modules will require several days or more. Stacked series of two or three modules should be considered to permit further development of knowledge and skills. Some of the topics identified in this review as needing further development foresters are: continuous cover silviculture, coppice management, forest health, invasive plants, ecology, and consultation.

In-person training could be backed up by the production of series of short information notes or simple keys. For example, training would be necessary to learn how to use the proposed habitat assessment key for foresters. Other skills may be developed through a mixture of guidance, discussion, and paper or web-

based information. An interactive web-based woodland plant key, such as that recently funded by the Heritage Council, is an example of a tool useful in developing the skills of students and professionals. Improvement of forest health assessment skills would be assisted by the production of short species descriptions, perhaps in the form of a series of notes with clear images and basic information. Similarly, the Native Woodland information note series produced by Woodlands of Ireland, and the manual produced by the Forest Service, form a knowledge base relevant to native woodlands. However, information on its own may be misinterpreted: it is important that discussion, field meetings, or a contact tutor are available to assist in incorporation of knowledge into practice.

Mentoring new graduates by professionals may also be an effective method of adding experience to education.

The required training should be delivered in partnerships between professional societies such as SIF and IEEM (Institute of Ecology and Environmental Management), Woodlands of Ireland, academic institutions, existing networks such as ESAI (Environmental Scientists Association of Ireland) and SkillsNet, and bodies such as Teagasc, NPWS and the Forest Service. The focus should be on cooperation and communication of opportunities. Exchange of information should be two-way: for example, not only will foresters and forest contractors benefit from a better understanding of forest ecology, but ecologists will benefit from a greater understanding of the techniques applied and the decision-making necessary in forest management.

Recommendations on training

- 1) Training should be planned and implemented by professionals and designed to address specific gaps in the skills base.
- 2) Training programmes may include discussion, presentation, field days,

and use of the internet and information series.

- 3) Training for professionals may fulfil a CPD requirement for Licensed Foresters (and some other professional societies requiring CPD, such as IEEM).
- 4) Training for foresters should involve:
 - Demonstration and training from outsourced professionals to promote awareness of later forest management.
 - Skills in multi-resource forest inventory and management planning.
 - Skills in identification and assessment of open and wooded habitats.
 - Forest health and diagnosis of pests and diseases.
 - Social forestry and consultation (see section 3.6.3 on consultation below).
 - Awareness-raising about skills which may need specialised professionals, such as ecological skills, recreation planning, and landscape design.
 - Refresher courses in modules perhaps rusty since graduation, such as soil classification and assessment.
- 5) Training for forest contractors and operators should include the following topics:
 - Soil vulnerability to compaction and erosion.
 - Application of best practice, together with implementation of the penalty system as discussed in Section 3.1.8 Forest management above.
 - Non-clearfell silvicultural systems (see Section 3.3.4.1).
 - Good coppice management and production of small diameter roundwood.
 - The successful pilot taught by Muintir na Coille in 2007 should be further developed and add-on modules incorporated.
- 6) Training for NWS-approved ecologists and FEPS consultants should include:
 - a) skills to identify non-forest habitats.
 - b) soil identification and surveys.

- 7) Other professionals should be included in training programmes offered by forestry and ecology institutions or societies, including REPS planners and forest health surveyors (as described above).

Benefits to heritage

The implementation of multifunctional forestry will be advanced by regular updating and expansion of skills among those working in forests. Cooperative provision of training will improve communication and exchange of information between organisations, institutions, and professionals.

3.6.3 Consultation

The Forest Principles adopted at UNCED that form the basis for sustainable forest management enshrine the principle of full participation by all interested parties in forest policy implementation. This has sometimes been given short shrift in Ireland. The experience of the Family Tree Scheme certificates in the People's Millennium Forests Project, in which many were disappointed to hear their trees might be thinned out at the age of 10 or 15, highlights the level of public interest in trees and forests, and the need for surveys to take account of public preferences. Recent consultations in Ireland are still one-way information campaigns or offer only narrow windows of opportunity for the public to have input.

Consultation on forestry issues in Ireland has improved in recent years, as has the recognition of its importance. However, improvement is still needed. The increasing requirement from the EU for public consultation provides impetus for improving how the public is engaged in social and policy improvements in Ireland. Involvement in planning and projects in a person's area or country can contribute to his or her sense of efficacy and therefore well-being. It is also arguably more democratic. Improvements are needed in two areas: institutional support for the time and planning requires should be improved,

and the practical techniques and skills of implementing consultation should also be more widely known and practised.

Behavioural economics highlights the importance of the social context of behaviour, regulation, and policy. Cultural and individual norms and preferences dictate people's responses in relation to proposals with regard to the natural environment. Increased participation and better framing of options can also contribute to our well-being by developing a sense of effectiveness. Many projects are likely to be more smoothly implemented by dedicating resources to a planned and comprehensive consultation process.

Public consultation is a two-way process: listening on the part of the project manager or forester is essential. Good consultation involves not only specific skills but also a listening attitude. It also requires informing as many people as possible of the opportunity to comment through public events, the mass media, word of mouth, the internet, and organisations such as the Heritage Council, Crann, and IFA.

Recommendations on consultation

- 1) The Heritage Council and forestry organisations of all types should promote best practice in consultation as an essential aspect of good forest management.
- 2) Competence centres in two-way consultation should be developed which can support CPD modules for foresters and other professionals. These centres should emphasise the importance of practical skills in planning consultation, different techniques, advertising the opportunity, engaging the public, broad outreach, disseminating accurate information, and listening.
- 3) Consultation methods should be actively improved on an ongoing basis and in conjunction with expert and

experienced input and ongoing qualitative research.

- 4) Grants should be made available to support consultation activities.
- 5) A manual on consultation would allow individual foresters to improve their skills. An excellent example is the guidance in *Interacting with Greenspace*⁵³. This manual, written for European audiences, should be adapted to reflect Irish culture and communities.

Benefits to heritage

Improved two-way communication with the public will increase a sense of involvement in natural resources and help establish multi-functional forest management more firmly in Irish society.

3.6.4 Public engagement

Consultation and public engagement are both topics firmly in the realm of social psychology, especially values and framing of perception. Consultation requires honouring public opinion where possible, while public engagement often involves increasing the knowledge base about the ecosystem being managed. Some public opinion may be based on a complex of personal and cultural factors but the knowledge is generally derived from the media or word-of-mouth. A case in point might be the response of public opinion and attention on global warming with abrupt changes in media reporting within a twelve-month period. In addition, we must grapple with overcoming a tradition of manipulating and misrepresenting knowledge and opinion.

Views are determined by perception, interpretation, and individual values. With regard to forests, public opinion is formed by perceptions of heritage, the place of nature, and the role of timber production. Heritage is increasingly valued by the Irish

⁵³ Van Herzele *et al.* (2005)

public⁵⁴. Broadleaf forests are commonly perceived to be part of that heritage, but this value is generally not extended to forests perceived to be plantations. However, the real situation is far more complex, as many of our valued apparently natural broadleaf forests were in fact planted or managed for timber in the past (see 1.1.2 on history of Irish forests).

Many forests have historical associations. They could be remnant forests with a history of coppice, charcoal burning, and holly fodder cutting, and which have a heritage value that is not immediately obvious (see Sections 3.1.2 and 3.2.4 about the importance of protecting these forests). The presence of species or the structure of the forest can be evidence of a former use. This history of use is in strong contrast to the often vaunted perception of naturalness and may be a way to increase public appreciation of forest management. This heritage could be promoted and explained by means of a forestry museum or woodworkers studios. The evolution of forest management over time should be considered in this museum: from ancient coppice to industrial uses to more recent expansion of forests. Public information on forestry should also connect forest management to the proud Irish farming tradition. This may help overcome the cultural resistance to growing trees on 'good land', as well as by highlighting the aesthetic, wildlife, recreational and environmental benefits of well-managed forests in accessible areas.

Engagement with the public, both for education and consultation, should take into account that individual attitudes are also influenced by associations and sense of place. For example, positive childhood memories may create in many adults a positive view of horse chestnut (*Aesculus hippocastanum*), and that positive evaluation may lead them to assume the species belongs to a group of trees valued as 'good': the native species. Old forests are perceived to be more valuable than

young forests and assumed to be non-commercial, while more recent commercial afforestation is seen as replacing natural habitat of greater natural heritage value. Interpretation means making conclusions from visual signs. A forest operation which looks messy is often interpreted as damaging the forest. This may be reinforced by word-of-mouth or other communication, highlighting the importance of evidence-based information.

Widely shared values, such as valuing the impression of wilderness, can be used as a gateway to inform the public. For example, dead wood invertebrates comprise one of the most disadvantaged groups of organisms in Irish forests. This could be addressed by provision of dead wood, and, simultaneously, developed into an education opportunity on the realities of forest ecology and the skills needed to truly assess an area.

There are many public forest-related events held in Ireland (e.g. during National Tree Week, Biodiversity Day, Heritage Week) but these are offered at introductory levels. At present, there are few opportunities for the interested recreational user to learn more beyond introductory talks without recourse to formal training. The importance of the science and application of professional ecology in forest management has not yet been fully recognised, either by the public or official agencies. There is an erroneous assumption that school nature studies are the equivalent to the knowledge held by professional ecologists, and this needs to be dispelled.

Recommendations on public engagement

- 1) Public engagement events and information should be designed to enhance the link between people and forests: enhancing appreciation of different types of forests, their management now and in the past, and the role they can play in enhancing

⁵⁴ Keith Simpson and Associates *et al.* (2007)

human well-being through various functions.

- Flagship species may be focal points for programmes for the public (see Section 3.2.4.2)
- 2) Different functions of forests should be foci of different public education campaigns:
 - A public education campaign on forests should be incorporated into the programme of awareness-raising related to the next National Biodiversity Plan. Topics which may be highlighted as contributing to better appreciation of the meaning and importance of Irish biodiversity include the role of the oceanic climate in enhancing diversity, the importance and variety of invertebrates, and traditional and historical and prehistoric use of forests, such as charcoal pits, holly for winter fodder, and coppice.
 - The following aspects need to be included in public education on timber and forestry:
 - Education in the use of wood, especially ecosystem-sympathetic wood use. Connect their kitchen cabinets with that tree, and emphasise lack of transport-related carbon in using their local trees.
 - Provision of information on forest certification and promotion of purchasing of independently certified timber (see Section 3.4.3 on Certification).
 - 3) An accredited naturalist training certificate should be developed for those wishing to either develop as a hobby their interest in nature or to learn to lead nature walks
 - 4) Public education on forestry matters must be reinforced by recognition and appreciation of biodiversity and professional ecology.
 - 5) A forestry museum would highlight the current and historical role of trees and timber in Ireland, the role of the forestry profession, past and contemporary forest management, and

the emerging approach of multi-functional forestry.

Benefits to heritage

An expanded public information campaign will promote the importance of forests and forest management in providing a wide range of good and services, but will also to present them as places of wonder and inspiration.

3.6.5 Research

Forest-related research is carried out in Ireland by academic institutions, Teagasc, Coillte, and other professionals. Funding is provided by various organisations such as the National Council for Forest Research and Development (COFORD), the Forest Service, and the Environmental Protection Agency. Project conferences, newsletters, and publications are important ways in which COFORD disseminates the results of research.

Research not only adds to the existing knowledge base and improves multifunctional management, but also encourages information exchange and improves education and training. Forest and ecological research studies need to continue to develop in rigor and method, with sufficient funding. Identification of research needs should be driven by researchers as well as by policy needs. Monitoring is essential, both for collection of data on long-term issues such as climate change but also to permit immediate response in areas such as forest health.

Further accurate reporting and publication access to authors is also vital. The usefulness and limitations of tools, such as spatial data, need to be acknowledged and improved. Sharing of data and skills between researchers and other professionals is to be encouraged. Furthermore, those carrying out externally-funded surveys should be encouraged to communicate their findings with the forest owner.

This review welcomes the increased recognition of multifunctional forestry as reflected in studies on the economics of recreation and public attitudes. Social research can inform some issues related to the role and function of forests about the role and function of forests. Social research suffers from a common misconception that robust answers are derived from simple lists of questions anyone can compile. This is incorrect. Question design, order, and the suitability of various statistical tests are crucial when exploring the social dimension of natural resources. Social research must be carried out with skill and planning if the answers are to be an accurate reflection of reality.

Recommendations on research

- 1) Forest research should continue be fully funded through COFORD and other bodies.
- 2) Ireland should become a member of European Forest Institute and participate more fully in pan-European research.
- 3) Research results should be widely communicated to the public as well as to professional audiences. The results should be used to inform practice, professionals, and education. Additional research specialisations should continue to be incorporated in multi-disciplinary projects.
- 4) The following topics are among those identified in this review as needing further research and monitoring:

Silvicultural topics

- Broadleaves as nurses
- Improved handling of broadleaf transplants
- The potential for broadleaf establishment on peatland sites, including broadleaf survival on deeper peats.

- The feasibility of natural regeneration on peatlands where conifers are being removed
- Support for silvicultural decision-making beyond the current standardised species mixtures and silvicultural systems
- Best application of continuous cover systems in native and other forests for timber production alongside conservation
- CCF and close-to-nature forestry systems, coupe size (especially in native woodlands), the ecological impacts of the different systems, and application to small-scale forests.
- Application of alternative silvicultural systems for small-scale forests
- Application of coppice and pollard systems to use on farms for timber, fuel, and biodiversity

Threats

- Forest health
- Landscape connectivity, and biodiversity, especially as climate changes
- Influences on biodiversity of invasive species.
- The impact of climate change on tree growth and health, and related evolving recommendations on site suitability for tree species.
- Impact of climate change, and performance of provenance and species

Ecological issues

- Grazing management in forests.
- Ecological impacts of various forestry operations, including impacts on soils and nutrients
- Ecological impacts and benefits of alternative silvicultural systems
- The role of forest buffers on aquatic systems
- Management and ecological role⁵⁵ of non-native broadleaves, including the impact on forest ecosystems

⁵⁵ See Peterken (2001)

- The role of forests in flood control and stabilising soils, linking this possible benefit with habitat defragmentation
- The potential impact of various forestry operations on soils and soil physical structure, resulting in recommendations for soil protection for Ireland.
- Evaluation of windrowing, which is no longer practised in many other countries because of damage to topsoil
- The contribution of forests on upland mineral soils to the water cycle and prevention of landslides
- The long term dynamics of long term retention / non-intervention stands on peatlands to assess its environmental cost-benefit

Social aspects

- Preferred forest structure
- The proportion of forest cover desired in the landscape
- Obstacles to recreation.

Benefits to heritage

Research affords the opportunity to steadily increase our store of knowledge about forest and their role in Irish society. Knowledge is vital to improve the management of forests and to increase their values, both tangible and intangible.



4. Conclusion

Forests provide a broad range of products and services that have different values to different people. It is the role of government to incorporate these values into forest policy and to ensure that the national forest resource is sustainably managed and therefore in a position to effectively deliver the associated products and services. Broadly speaking, the modern era of Irish forestry has focussed primarily on the economic (timber production) function of forests and it is only recently that more careful attention has been paid to the ecological and social functions they provide. These functions can in general terms be considered an expression of the heritage value of the forests. It is in this context that Irish forestry finds itself today: on the one hand, we have a resource that has been established primarily with a timber production objective; and on the other hand, a growing appreciation that the heritage value of forests, although generally intangible, is in many cases as high as the timber value.

Now, the great challenge is to manage the expanding Irish forest resource in a way that sustains and enhances its multiple functions. There are clear indications that the forestry sector is facing up to this challenge and has taken the first steps to embrace the concept of sustainable forest management and multi-functional forestry. However, forestry is a long-term land-use, and it must be accepted that there can be no overnight transformation from the pioneering sector of today to a fully integrated forestry sector tomorrow. It is now time to support the sector through continued research, training, professional development and multi-disciplinary partnership as it enters this new era. All the services our forests provide to society, from biodiversity to recreation to fuel, should be the focus of professional multi-resource management. Future challenges, with increasing numbers of invasive species and with the anticipation of rapid climate change, should also be themes in forest management and protection. This

will need to be underpinned by a new and visionary national forestry policy with the commitment to sustainable forest management enshrined in law.

Forestry is a unique enterprise because of its ability to provide so many services to so many people. It is essential that we take measures to protect these functions from the real threat posed by climate change and from invasive plants, animals and diseases. There are other socio-economic changes in train, such as increased urbanisation and rising energy prices, which affect the demands on forests. A strong yet dynamic forestry sector is required to cater for such changes while protecting their heritage values. This review was called for to provide input into the strategic development of forests in Ireland, emphasising biodiversity protection and enhancement. This report has presented a vision of how the forestry sector might look in three decades' time and provides a series of discussions and recommendations indicating how this might be achieved. The authors hope the report will point a way forward for ecologically healthy and economically robust forests providing many ecosystem services to Irish society.



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Individuals and organisations consulted:

Aine Ni Dhubhain, UCD
Áine O'Connor, NPWS
Alastair Pfeiffer, Coillte

Anja Murray, An Taisce – The National Trust
Anne Oxbrough, UCC
David Fallon
David Norriss, NPWS
Declan Cooke, NWRFB
Declan Little, Woodlands of Ireland
Dermot Tiernan, Coillte
Diarmuid McAree, Forest Service
Evelyn Moorkens, mollusc ecologist
Prof. E.P. Farrell, UCD
Frank Barrett (IFS – GIS capabilities)
Gerry Murphy, Coillte
Ian Short, Teagasc
Irish Farmers Association: Farm Forestry Section
Jeri Peck
Jim Ryan, NPWS
John Connelly, NWRFB
John Cross, NPWS
John O'Halloran, UCC
Julie Fossitt, NPWS
Mark Wilson, UCC
Michael Doyle, private forestry consultant (formerly Coillte)
NPWS conference attendees
Padraig O'Tuama, Coillte
Paul Scott, Cawley Scott
Phillip Carr, Forest Service (coordinating FS submission)
Phillip McGinnity, Dept. of the Marine
ProSilva Ireland: Paddy Purser
Richard Mole, UL
Sandra Irwin, UCC
Superintendent's Office, Gardaí, Galway
Tara Ryan & Michael Carey, Irish Timber Growers Association
Tim Crowley, Coillte
Toddy Radford, Teagasc
Tom Gittings, UCC
Tomás O'Leary, MosArt Architecture Landscape and Research
Tony Mannion, Society of Irish Foresters



Appendix 1: Tender brief

Review of the Heritage Council Forest Policy

Introduction

In 1999, the Heritage Council published a document entitled 'Policy Paper on Forestry and the National Heritage' (see <http://www.heritagecouncil.ie/publications/index.html> under 'Forestry'). Since then, considerable developments have occurred within the forest sector, including changes in the national forest policy, the development of forest certification, the impact of climate change, the emergence of alternative wood products such as wood fuel, and the focus on non-timber benefits such as recreation and public health, biodiversity, carbon sequestration and protection. Consequently, the Heritage Council is initiating a wide ranging review of its current policy to reflect this changing context and to provide a vision for the future development of forestry in Ireland, with a particular emphasis on the national heritage. The output of this review will stimulate debate and feed into discussions on national forest policy and the development of forest certification standards in Ireland, especially the Forest Stewardship Council (FSC) process.

Previously, the Heritage Council reviewed the 1999 policy document in 2002 (also at <http://www.heritagecouncil.ie/publications/index.html> under 'Forestry'). However, it is considered appropriate to broaden the scope to account for new developments and trends in this sector.

Woodlands of Ireland is acting as facilitator and co-ordinator of the process. The Woodlands of Ireland group was established in 1998 with funding from the Heritage Council, the National Parks and Wildlife Service and the Forest Service, to advance the appropriate management and expansion of the native woodland sector (see woodlandsofireland.com). Tenders are invited for a wide ranging review of the current Heritage Council forest policy, with particular emphasis on social, environmental and economic requirements. The current Heritage Council policy document and associated document mentioned above will form the basis of this review.

Purpose of the review

The purpose of the review is to update the Heritage Council forestry policy and to input into the strategic development of forestry in Ireland, with an emphasis on biodiversity protection and enhancement.

Scope and content of the study

In developing a vision of Ireland's future forest estate, the following issues should be addressed:

Forest policy, legislation, certification and incentives – outline recent changes that are currently shaping forest practice. A listing of the potential impacts of current national forest policy and practice on the wider landscape, with emphasis on the biodiversity heritage.

Species and site suitability – with more lowland sites becoming available for afforestation, an assessment of the potential for greater species diversity, particularly broadleaves, is required, which would enable defined targets to be developed. Outline targets for afforestation using diverse conifer and broadleaf species, including native species, for commercial, environmental, protection and amenity purposes.

Biodiversity - Recommendations regarding future targets for conserving and expanding native woodlands should also be included. Recommendations to resolve the conflict between conifer afforestation and the decline of other habitats on marginal land impacted upon by this activity. Particular emphasis should be placed on the development of possible incentives for the conservation of these areas and the co-ordination of current incentives such as the Rural

Environmental Protection Scheme (REPS) and forestry schemes, i.e. the Native Woodland Scheme (NWS) and the Forestry Environment Protection Scheme (FEPS).

Amenity considerations – the potential for, and development of, targets for amenity, recreational and educational woodlands in the urban, peri-urban and rural landscape, taking into account recent trends/initiatives in the area of forest/countryside recreation, and focus on public health and well-being (e.g. anti-obesity).

Silvicultural systems – in Ireland, silvicultural systems are currently dominated by clearfell. Outline the potential to expand the range of alternative silvicultural systems.

Protection functions – the use of woodland buffers to protect and enhance freshwater systems and water quality, especially in light of the EU Water Framework Directive and other relevant legislation. Other protective functions of forests, such as soil stabilisation and flood control measures should also be considered.

Climate change – due cognisance of the likely impact of climate change in Irish forestry, especially species selection and the higher incidence of pests and diseases. In addition, account should be taken of the role of Irish forestry in carbon sequestration, its contribution to Kyoto Protocol targets and the National Greenhouse Gas Abatement Strategy.

International trends and markets – assessment of current forestry trends internationally in order to recommend future strategies for production and marketing of Irish forest products.

National trends and future forestry potential – account for the impact of other landuses on Irish forestry, e.g. forests are being sold for development in some areas, whilst other green field areas are reverting to woodland naturally due to changes in agricultural Policy. In addition sites that were previously afforested with conifer crops which are deemed to be economically and environmentally unsustainable are being felled and a new approach towards reforestation same is required. Similarly, outline the potential for broadleaf forestry on greenfield sites in acid sensitive areas which are unsuitable for conifer crops.

Forestry and the landscape – the impact of forestry on the landscape heritage particularly size of clearfell and the adoption of continuous cover silvicultural systems.

Public perception and attitudes toward forestry - changes in public attitudes to forestry as a landuse should also be accounted for in the review.

Training and research - gaps in all the above areas should be identified to enable policy to be implemented. In particular, details of training and research needs currently required to diversify forest practice should be outlined.

The study should include the following:

- Literature review: this should include the two Heritage Council documents on Forest Policy referred to in the Introduction above as well as relevant national forest policy documents available from the Forest Service at <http://www.agriculture.gov.ie/index.jsp?file=forestry/pages/index.xml> under 'Publications')
- The scope of research and methodologies used (questionnaires, interviews, etc.).
- Consultation with environmental, economic and social forest stakeholders, including ENGOs, state agencies, forestry and ecological experts, educational and research institutions, and community groups with a particular interest in forestry.
- Recommendations on future forestry development potential.

Appendix 2: Summary of public consultation submissions

Sixty-two individuals and organisations made submissions to the team during the public consultation phase. Some of the same people were among the twenty-two who attended the public meeting in November and contributed to the discussion. Submissions were made by recreational users, foresters, forest owners, industry representatives, environmental NGOs, scientists researching aquatic and terrestrial ecosystems, and an anonymous poet.

Several respondents proposed the creation of a new forestry development agency, and one made the case for a new independent statutory body for forestry to act as the innovator and custodian of forest policy as well as overseeing the implementation of forest laws. It was suggested that forest policy and indicators for monitoring the social, environmental and economic successes of forestry should be set by a multi-disciplinary group, and another that the government should be the main driver behind forest certification.

Many of the respondents remarked that forestry is a long-term enterprise. Afforestation represents a long-term commitment by the landowner and this means that the support structures should be consistent over time. The lack of stability in State funding, and the lack of statistics on timber, were highlighted as administrative shortfalls. Integration of the various schemes was described as in need of improvement. One industry representative remarked that agricultural supports and environmental constraints had undermined the rate of land transfer to forestry and were the main reasons for the low planting levels that threaten the viability of the sector.

The choice of tree species has received much attention in debates on forestry. There were many calls for increased planting of broadleaves, exotic and native, and native trees, both broadleaves and Scots pine⁵⁶. It was suggested that aiming for a certain area of broadleaves was a better target than stipulating a certain proportion of broadleaf planting. Some submissions acknowledged that availability of better quality land would help diversify the tree species being planted, and site and soil surveys were called for prior to species selection. The need for species to fulfil owners' objectives was also mentioned. Other submissions called for planting broadleaves for environmental and aesthetic reasons. A note of caution was sounded that although hardwoods will continue to demand high prices, they have long rotations and should be increased gradually. One industry respondent's opinion was that much recent afforestation consists of inappropriate species, mainly broadleaves, and that most broadleaves are essentially non-commercial. A few respondents made reference to reinstating forest vegetation communities where they are known to have existed prior to human intervention. At the same time, ecological assessment of sites prior to afforestation was also strongly recommended, along with the research-based development of indicators that could be used for rapid assessment of these sites. Maintenance of biodiverse non-forested sites called for. Some submissions noted that with climate change, the successful species might be different from the ones now used, and the need to consider the changes over the term of a forest development were highlighted.

Several respondents emphasised the varying contribution of different types of trees – conifer and broadleaf, evergreen and deciduous, high forest and shrub – to the services provided by forests. The role of non-conifer forests in the protection and restoration of riparian zones was highlighted by several respondents, and the impact of forest operations and forest road

⁵⁶ As Scots pine is acceptable under the current Native Woodland Scheme, despite the strong but not entirely agreed probability that it died out in Ireland with climatic mitigation, it is treated as native in this summary.

construction on aquatic ecosystems was also discussed in several submissions. In addition, the psychological and spiritual sense of specific types of forests was highlighted as extremely important.

The forests of the future were described as taking rural livelihoods and quality of life into account, along with the environment and heritage. A whole-farm approach was called for, in which farmers would be better equipped and trained to manage and thin their own forests to produce good quality timber. Thinning grants were suggested, as were regional cooperation between landowners to share costs of thinning. The need for promotion of Irish forests and timber was highlighted. The need for management plans for all forests incorporating silvicultural and ecological expertise was also mentioned.

Transport costs, both with imports and within the country with regard to processing, were highlighted as requiring better planning and reduction of transport. The need to recognise the global impact of forest and timber use in Ireland and to develop locally-grown timber – particularly hardwood - sources and markets were highlighted. Sustainable forest management and independently evaluated certification was highlighted by some respondents, who propose encouraging wider adoption of certification among small forest owners. Permaculture, agroforestry, and coppicing were mentioned as deserving greater attention. A note of caution in rushing into fashionable programmes, such as supporting production of woody biomass and also the buzz around carbon sequestration, was sounded, advising that programme development follow research. Other respondents called for courses for landowners in woody fuel production and rewarding the forest owner for carbon sequestered in his or her trees.

Some respondents noted the potential for public education through development of a network of heritage forests, and a forestry museum was also suggested. Research, especially long-term research to match the long-term nature of forestry, was mentioned as a crucial need. The role of research and professional experience in informing best practice was emphasised.

There were calls for additional training, including guidance for contractors, more detailed guidance on management of open space in plantations, as well as opportunities for non-foresters to receive some certified training in non-clearfell systems and in managing their forests for recreation and tourism activities. The need for practising foresters to gain education in recreation, environmental, and landscape aspects of forests was also mentioned.

Self-sufficiency in timber was a theme in some of the submissions. One respondent recommended that Ireland should aim to be self-sufficient in timber but warned that forestry should be developed alongside efficient food production, which will become more important as food imports become more expensive. The importance of non-timber values of forests were highlighted by many respondents. The non-timber services highlighted included landscape aesthetics, the link to the heritage of landscape and woodland use, conservation and biodiversity, nature education, carbon sequestration, woody biomass, small diameter logs, recreation, and artistic pursuits. The importance of all the different functions of forests being acknowledged in the market and benefiting the owner was mentioned in several submissions. Some stakeholders pointed out that cooperatives of forest owners may be able to together find new products or markets, which could encourage a greater diversity of tree species to be planted. Some believed there is need to consider over-exploitation of some non-timber products in a changing world.

The development of a landscape strategy and use of incentives in encouraging better landscape planning and forest strategy were mentioned, along with the need for detailed soil information. Environmental obligations such as the Strategic Environmental Assessment

Directive were noted by several respondents. A national need for some large broadleaf forests and wildlife corridors was also noted. At the same time, many of the submissions called for greater flexibility in not replanting after felling, especially where environmental vulnerabilities would be better protected by restoring the original habitat, and consideration of a forest site within the patchwork of habitats in the landscape. It was also suggested that these site should be actively restored rather than abandoned post felling.

Submissions reflected both the biodiversity contribution of well-managed forests, especially those with native trees, and the importance of protecting ecologically valuable habitats and sites of built heritage from afforestation. However, the relative contribution of different species of trees was noted, as were recommendations by researchers to improve biodiversity. Research on sites where woodland may have been maintained for centuries was recommended.

Some uses, such as landfill and litter, were noted as inappropriate in a forest site.

The special role of publicly-owned forests was is to serve the public, through production of timber or other services, and the need for any surplus to be invested back into the public forests.

Several of the submissions encouraged greater use of continuous cover silvicultural systems, limits to the size areas being felled in any one operation, creation of mixed-age stands which are maintained permanently, enhancing services such as landscape and biodiversity, while still fulfilling needs for timber. It was pointed out that suitable systems will vary by species of trees being managed.

Calls were made for better consideration of open space in plantations and wildlife corridors in timber production areas as well as in the landscape in general. Respondents suggested avoiding planting conifers in areas where exposure prevented management under continuous cover systems and some trees could be retained as veterans and to consider the landscape and recreational user in designing forests. Several respondents pointed out the need to address the loss of suitable habitat for mussel, beast or walker through some forestry operations as currently practised, and some proposed use of horse and other small-scale techniques perhaps used in the past. Specific considerations such as trees with holes for bats, halo thinning or early and frequent thinning to increase abundance of food insects were highlighted. The need for better consideration of archaeological heritage and inclusion of not-yet-recorded monuments was mentioned.

Long-term retention of some forests (particularly with native species) was recommended because this provides habitats for rare species such as late-successional fungi.

Urban trees were also highlighted as being an important resource which should be inventoried, monitored, and cared for.

Use of pesticides and other chemicals was a matter of concern to some respondents, in particular with regard to impact on insect predators, soil and vegetation diversity, and aquatic ecology. Matching species with site was proposed as a way to reduce fertiliser use. Phosphorous inputs to waterways were pinpointed as of particular concern. Resilience of forests in the face of climate change was also pointed up.

Threats, especially deer and grey squirrel, as well as threats from future climate change, were highlighted in several submissions as urgent issues.

Some identified the pressing need for the authorities to engage more with the public and with stakeholders.

The number of recreational organisations that responded points to the significance of forests and the uplands for recreation. Some commented that timber extraction could be better integrated with recreation, habitat, and landscape aesthetics. Others proposed specific recreational public forests with trees selected for aesthetic and recreational contribution. Some felt recreational development is straightforward. Others addressed the issue of how a forest owner might receive support for allowing recreational use. The contribution of recreation to public health, quality of life and potential tourism income was noted in several submissions. It was also suggested that public attitudes will become more positive towards forestry with increased public access and enjoyment of Ireland's forests.

List of people and organisations who made submissions (written or verbal)

Aidan French, The Irish Landscape Institute
Alistair Pfeifer, Coillte
Anne Morrissey, President Irish Ramblers Club
Anonymous (two)
Aodhanit Carroll, Access & Conservation Officer, The Mountaineering Council of Ireland
Barbara Maguire, Farm Forestry Development Officer, The Irish Farmer's Association
Bob Wilson, Director of Clare Biodiversity Group, Director of CELT (Centre for Environmental Living and Training)
Brendan Maguire, NRFB
Bridgeena Nolan, Principal Officer, Policy, Forest Service
Caroline Lewis, Friends of the Irish Environment
Cathal Spelman
Ciara Hinksman, The Mountaineering Council of Ireland
David Herman, Irish Ramblers Club
Dr. Declan Little, Woodlands of Ireland
Derek Gray, Dublin Mountains Initiative
Dermot Tiernan, Coillte
Dr. Elvira de Eyto, Marine Institute
Fergal Mulloy
Fiona Mulholland
Gavan Doherty, Irish Orienteering Association
Dr. George Smith
Gerry Murphy, Coillte
Gordon D'Arcy
Helen Lawless, Wicklow Uplands Council
Jan Alexander
Jenni Roche, Postgraduate Student, Department of Botany, Trinity College, Dublin
Joe Barry, Crann
John Conneely, Acting Chief Officer, North Western Regional Fisheries Board
John Haughton, Forest Friends Ireland
John Jackson, IFA
John Joyce
Prof. John O'Halloran, UCC
John Phelan, Woodland Managers Limited
John Griffin, Forest Service, Department of Agriculture and Rural Development, Northern Ireland
Justin Rea, Dublin Mountains Initiative; Irish Mountain Runners Association; Irish Orienteering Association
Dr. Kate McAney, The Vincent Wildlife Trust

Kevin Rogers, Senior Environmental Officer, The Western Regional Fisheries Board
Dr. Mary Tubridy, Irish Uplands Forum
Monika Muller
Myles MacDonnacha
Dr. Niall O'Carroll
Noel Kennedy, Roscommon Forestry Forum
Dr. Nuala Ni Fhlartharta, Forestry Development Unit, Teagasc
Oisín Ó Conail, Wexford Flower & Foliage
Paul Dunne
Paul Murphy, EirEco Environmental Consultants
Paul O'Dwyer, Nutrisolv Ireland Ltd, Environmental Services
Pierre Prouteau, Forest Enterprises Ltd
Ralph Sheppard
Dr. Richard Schaible, Head of Forest Practice, Forest Service, Department of Agriculture and Rural Development, Northern Ireland
Sarah Malone, Conservation Officer, IPCC
Simon Spratt
Siobhán Egan, Senior Conservation Officer – Policy, BirdWatch Ireland
Stuart Dunlop
Tara Ryan, ITGA Secretariat
Prof. Ted Farrell, UCD
Tim Crowley, Coillte
Tony Mannion, Society of Irish Foresters
William Hartnett, JD, PhD

Appendix 3: Summary of national and international obligations relating to forest management in Ireland

National laws

Legislation	Potential Impact
<i>Wildlife Acts, 1976 and 1999 Wildlife Amendment Act (2000)</i>	<i>Flora, fauna, environment and forest management</i>
<i>Forestry Acts, 1946, 1956 and 1988</i>	<i>Forest management</i>
<i>Local Government (Planning and Development) Acts, 1963 to 1999</i>	<i>Control of development and forest management</i>
<i>Planning and Development Act, 2000 Commencement (No. 3) Order, (2001) S.I. No. 599 of 2001. Planning and Development Regulations (2001) S.I. No. 600 of 2001.</i>	<i>Control of development and forest management</i>
<i>National Monuments Acts, 1930 to 1994 (Including Approval of Consent (1) Order, 1995)</i>	<i>Forest management</i>
<i>Occupiers Liability Act, 1995</i>	<i>Forest management</i>
<i>Safety Health and Welfare at Work Act 2005. Safety Health and Welfare at Work - General Application Regulations (1993) and Construction Regulations (2001)</i>	<i>Forest management both in forest and in office</i>
<i>Environmental Protection Agency Act, 1992</i>	<i>Forest management and environment</i>
<i>Heritage Act, 1995</i>	<i>Heritage protection</i>
<i>Environmental Impact Assessment – S.I. No. 100 of 1996</i>	
<i>European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1996. S.I. No. 101 of 1996.</i>	
<i>Local Government (Water Pollution) Acts, 1977 to 1990</i>	<i>Forest management and environment</i>
<i>European Communities (Environmental Impact Assessment) (Amendment) Regulations, 2001. S.I. No. 538 of 2001.</i>	
<i>Waste Management Act, 1996</i>	<i>Forest management and environment</i>
<i>Local Government (Special Amenity and Conservation Orders) Act, 1976</i>	
<i>Litter pollution Act, 1997</i>	<i>Forest management and environment</i>
<i>Occupiers Liability Act 1995</i>	<i>Forest Management</i>
<i>Roads Act, 1993</i>	<i>Haulage</i>
<i>Road Transport Acts, 1932 to 1999</i>	<i>Haulage</i>

European (EU) laws pertinent to forest management in Ireland:

Legislation	Potential Impact
<i>Council Directive (92/43/EEC) and amending directives on the conservation of natural habitats of wild fauna and flora</i>	<i>Flora and fauna and forest management</i>
<i>Council Directive (79/409/EEC) and amending directives on the conservation of wild birds</i>	<i>Wild birds and forest management</i>
<i>EU (Conservation of Wild Birds) (Amendment) Regulations 1999</i>	

Legislation	Potential Impact
<i>European Communities (Natural Habitats) Regulations, 1997</i>	
<i>European Communities (Natural Habitats) (Amendment) Regulations, 1998</i>	
<i>Council Directive (2000/60/EC) establishing a framework for community action in the field of water policy</i>	<i>Forest management and the environment</i>
<i>Council Directive (2000/29/EC) on protective measures against the introduction into the Member States of harmful organisms of plants or plant products and against their spread within the Community</i>	<i>Forest protection</i>
<i>Council Directive (1999/105/EC) on the marketing of forest reproductive material</i>	<i>Tree improvement and forest protection</i>
<i>Council Directive (85/337/EEC) and amending directives on the assessment of the effects of certain public and private projects on the environment</i>	<i>Control of development</i>
<i>EU Water Framework Directive (Directive 2000/60/EC)</i>	<i>Water</i>
<i>Council Regulation (EEC3528/86) on the protection of forests against atmospheric pollution</i>	<i>Environment</i>
<i>EU Strategic Environmental Assessment Directive (Directive 2001/42/EC)</i>	<i>Environment</i>

Information in the above tables was derived from Maguire (2001) and McHugh and Gallagher (2004).

International agreements and protocols pertinent to forest management in Ireland:

a. International Labour Organisation - Conventions

- Freedom of Organization
Convention 87 on Freedom of Association and Protection of the Right to Organise, 1948
Convention 98 on the Right to Organise and Collective Bargaining, 1949
- Abolition of Forced Labour
Convention 29 on Forced Labour, 1930
Convention 105 on Abolition of Forced Labour, 1957
- Equal Rights / No Discrimination
Convention 100 on Equal Remuneration, 1951
Convention 111 on Discrimination (Employment and Occupation), 1958
- Child Labour
Convention 138 on Minimum Age for Admission to Employment, 1973

b. International Agreements

Ireland has signed the following international agreements, among others:

- the *Bern Convention* of 1979 for the preservation of Europe's wild animals and native plants and their natural habitats;
- the *Convention on Biological Diversity* of Rio de Janeiro of June 5, 1992, concerning biological diversity;
- the *Bonn Convention* of June 23, 1979, for the preservation of migrating wild animal species;

- the *Washington Convention on International Trade in Endangered Species* (CITES) of March 3, 1973, concerning the international trade in endangered species of wild animals and plants.
- the *Ramsar Convention on Wetlands*, 1971 - an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 45 Ramsar sites in Ireland.
- the *Kyoto Protocol*, negotiated by more than 160 nations in December 1997, aims to reduce net emissions of certain greenhouse gases (primarily carbon dioxide (CO₂)).
- the *International Tropical Timber Agreement* of 1994 which seeks to improve the international market conditions for sustainably grown tropical timber.
- the *Helsinki Protocols* resulting from the Ministerial Conference for Protection of Forests in Europe, 1994.
- the *Lisbon Protocols* resulting from the Ministerial Conference for Protection of Forests in Europe, 1998.
- The Vienna Protocols resulting from the Ministerial Conference for Protection of Forests in Europe, 2002.
- The United Nations *Framework Convention on Climate Change* in 1992.
- *Convention Concerning the Protection of the World Cultural and Natural Heritage*, Paris, 1972
- *the Aarhus Convention*
- *The European Landscape Convention, 2000.*

Appendix 4: Literature review of carbon sequestration, climate change, and trees in Europe

Carbon sequestration was not addressed in the Heritage Council 1999 policy paper, but is relevant to current policy. *The pursuit of carbon sequestration could compromise the vision of a more truly sustainable forestry in the future. Inaccurate and misleading statements have been made by officialdom and politicians about the supposed benefits of Ireland's current forestry policy for carbon sequestration. The Heritage Council might choose to play a role in weeding out the bad science and promoting debate that considers all the issues involved. Arguments for using fast-growing conifers in short rotations to 'mop up' excess carbon dioxide probably do not stand up to rigorous scrutiny, especially when ecological sustainability is also considered. This latter point has yet to be emphasised in official statements on the issue. The role of peat soils and agricultural land generally also needs to be considered more carefully. Additionally, there is counter evidence that close-to-nature forestry, using longer rotations, is more beneficial in achieving carbon sequestration in the longer term (Hickie 2002).*

The received belief is that increased planting of trees leads to a net reduction in CO₂ and hence has a beneficial effect on climate change. It is true that plants utilise CO₂ in their physiological respiration, and if nutrient supply is adequate, the plants may take up extra CO₂. The issue under discussion, in this review, is not whether trees sequester carbon, but the extent to which this may be measured as an offset against emissions in the absence of full Life Cycle Assessments (LCAs). An additional concern for this review is whether this is beneficial to heritage or an accounting system for reporting on the GHG Abatement Strategy.

For example, LCA of transportation fuels from biomass resources involves a 'cradle to grave' evaluation of energy and environmental issues associated with producing, collecting and transporting the biomass, converting the biomass into transportation fuels, and distributing and using the transportation fuel in motor vehicles. Biomass transportation fuel LCAs frequently include an assessment of the petroleum derived product that they will displace (e.g., petrol, diesel), as a means to compare the two products. Energy and environmental issues examined include crude oil used, non-renewable energy consumption, greenhouse gas emissions, photochemical smog formation, acidification, and eutrophication.

LCA methodologies have been standardized by the International Organization for Standardization⁵⁷ and include guidelines to establish the goal and define the scope of the analysis (i.e., define methodologies, reference condition, system boundary, etc.), to conduct the inventory analysis (i.e., collect inputs/outputs and environmental burdens associated with the processes and normalize the environmental impacts to the reference conditions), to conduct the impact assessment, and to interpret the results.

Environmental impacts associated with changes in soil characteristics (i.e., soil organic carbon; N₂O, NO_x, NO₃⁻ emissions from the soil) vary with soil type and physical characteristics (e.g., slope), climate, and tillage and other management practices. Crop yields and fertiliser and chemical input levels are also important.

The analysis includes the transportation of the biomass resource on site and to the conversion facility. Impacts on soil attributes (i.e., soil organic carbon dynamics, inorganic nitrate losses due to leaching, and nitrous oxide and nitrogen oxide emissions from soil) in each county may be estimated using models which simulate long-term (100 to 1,000 year)

⁵⁷ ISO 1997, 1998, 2000a, 2000b

soil carbon and nitrogen impacts for different ecosystems (e.g. agricultural crop production, grass systems, etc.) resulting from changes in climate, land use, and management⁵⁸. The model should estimate N₂O, NO_x and N₂ emissions from soil resulting from nitrification and denitrification. Required information: temperature and precipitation, site-specific soil properties (i.e., soil texture, soil organic content, soil moisture content, and soil mineral content), and the current and historical cropping system. The characterisation factors for acidification, eutrophication and photochemical smog formation may be adapted from other studies.

Ireland had circa 1% tree cover at the beginning of the 20th century. One hundred years later the land area covered by trees is circa 11%. This is due to a policy that is, and was, driven by goals other than CO₂ sequestration. This only became an issue in the late 1990s. The planting of trees had several purposes initially, a strategic resource, rural employment, utilisation of marginal land. Essentially, the building of an industry. In recent years the added benefits of forestry have been highlighted, such as effects on hydrology, soil improvement/stability, wildlife habitats and possible benefit in carbon sequestration.

Young plantations on peat sites have been shown to be net CH₄ emitters, and although there is evidence that this reduces with forest age, it is not clear how many years of growth are required to offset the release of a gas that has 21 times the radiative forcing⁵⁹ (GHG effect) of CO₂⁶⁰.

Read and Shepherd (2007) have concluded that forests and forest soils may not be good carbon sinks and as global temperatures increase they may become GHG emitters. Bala *et al* (2007) conclude that mid and high latitude forests may have a warming effect, since the dark vegetation absorbs heat and has a net warming effect overcoming any benefit to carbon sequestration. Indeed they argue that the only areas that may have a benefit are the tropical regions below 20 degrees of latitude.

Current EU policy in global warming debates opposes that of the Japan, Switzerland, Canada, Australia, Norway, New Zealand, Russia and the US (the Umbrella Group) to use forests as offsets to emissions. The EU argues that this would delay the reduction of emissions which is the real problem, and calculating offsets for forests is not realistic. Current research would appear to support this argument and implies that Ireland should be very cautious in attempting to use its forests as a potential offset. The science is complex and bandwagoning has led to many groups leaping before looking (an example would be the first generation biofuels from oilseed rape recent LCA studies indicate that CO₂ emissions are 50% greater through the cycle than if we burned fossil fuels directly). If we consider the large areas of forest Ireland has planted on peats and the above-mentioned research, it may be prudent for us to promote forests for reasons other than carbon sequestration.

However, the Forest Service calculates carbon sequestration in its forest inventory and planning system (FIPS). Figures have been quoted but not released. Attempts to quantify CO₂ captured by Irish forests have, of necessity, adopted a broad brush approach. Byrne and Milne (2006) made an attempt at estimating carbon sequestration in Irish plantation forests. They make broad assumptions concerning the areas planted since 1906 and changing yield class. Up to 1989, Sitka spruce was assumed to be YC16, all other conifer were assumed to be YC8, while all broadleaves were assumed to be YC6. Since 1990, they

⁵⁸ Del Grosso 2000, 2001; Natural Resource Ecology Laboratory, 2005

⁵⁹ Radiative forcing is the amount by which a variation in the abundance of a greenhouse gas, compared to its abundance in pre-industrial times, changes the radiation energy budget of the Earth, if we change the abundance of the greenhouse gas but we do not alter the temperature and other properties of the surface and the troposphere.

⁶⁰ Maljanen *et al* 2001

assumed that Sitka spruce was YC20. They estimate that the total forest carbon stock in 2002 was 37.7 Mt and predict that this will increase by 0.9MT C year⁻¹ up to 2012. Even if this was accurate, and they describe it as an estimate, it only represents approximately 22% of Ireland's reduction commitment under the Kyoto Protocol.

Byrne and Milne (2006) realise that afforestation on peat soils reduces the net C sink but were unable to definitively account for variations in their model. Since a large proportion of Irish forests are planted on peats this makes C accounting very difficult.

In Ireland, there has been significant growth in greenhouse gas emissions, whereby in 2003 GHG emissions were 25% above 1990 level compared to a reference target of 13%. The emission of carbon is a global problem and the real issue is the reduction in carbon emissions and targeting areas of the world where reforestation can have some effect on climate change.

Undoubtedly, forest trees sequester carbon as part of their physiological respiration and growth. However, support for forests as net carbon sinks and assisting in reaching our commitments to the national GHG abatement strategy is difficult to quantify from a scientific and heritage perspective. COFORD are currently funding a series of research programmes that may assist us in quantifying Carbon sequestration but they will not be completed for some years.

Current COFORD Research Programmes on Climate change:
CARBIFOR II - Carbon sequestration in Irish forest ecosystems
CARBWARE - Development of tools and systems for reporting on forest carbon stocks and stock change under the Kyoto protocol and the UNFCCC
CLIMADAPT - The use of Ecological Site Classification in adapting forests and their management to climate change
FORESTSOILC - Soil carbon stock changes and greenhouse gas fluxes in Irish forests
WOODCARB - Carbon stocks and carbon changes in harvested wood product

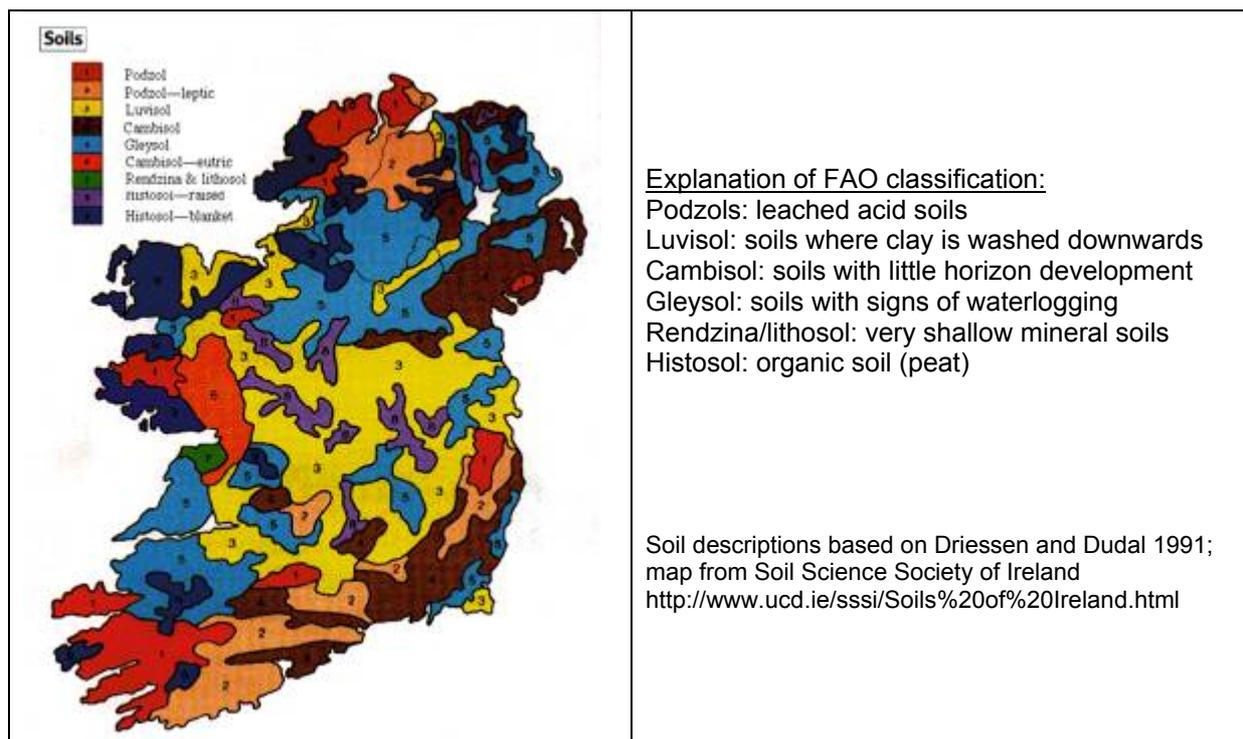
The Forest Service has a declared strategy to afforest 17% of the land area in the Irish Republic. This will still leave Ireland with one of the lowest areas of forest cover in the EU and that is if we achieve that target.

If climate change continues in the direction indicated by Sweeney et al (2005) then many of our exotic tree plantations will essentially be 'off site', leading to stress that causes disease and insect problems. In this scenario Ireland's forests could become net emitters of carbon. It is recommended that we support the continued afforestation of Ireland but for reasons other than CO₂ sequestration. Other methods of planting and managing forests should be examined to enhance the services that can be provided by forests, e.g. soil stability, stabilising hydrological cycles, providing habitats for wildlife, recreation and a sustainable supply of wood and non-wood forest products.

To put our afforestation into perspective with regards to global climate change, in one week in Greece (August 2007) 2.4 million hectares of agricultural land and forests were destroyed by fire. Considering Ireland has approximately 750,000 hectares of forest planted it can be seen that in global terms any contribution to CO₂ capture and sequestration is negligible. Ireland has far exceeded its GHG emissions allowance and our forests will not contribute substantially to mitigating these emissions. We have already observed that it is extraordinarily difficult to calculate the contribution of the forest estate to carbon sequestration and recommend that we support a sustainable afforestation programme that would proceed in any case.

Appendix 5: Soils and forests

Soils can be defined in a variety of ways⁶¹, but most definitions share the concept of a weathered mineral layer under vegetation and overlying rock or mineral deposits. Although soils across the globe are most often derived from weathered rock (mineral soils), organic soils, derived from undecomposed plant material, are relatively common in the humid, cool Irish climate. In fact, most soils in Ireland are dominated by the damp climate, either because of leaching or due to waterlogging (see Figure 1, below).



Because Ireland was subject to glaciation repeatedly up to just over 10,000 years ago, the soils in Ireland are relatively young and often shallow. In addition, the parent material contributing the mineral portion of a soil may not be hard geology but instead often comprises glacial deposits, which may overlie the bedrock to varying degrees of thickness⁶². These deposits are composed of weathered soil material which was moved by ice masses, providing rooting but little nutrition for plants.

Although mineral soils are constantly being created, the rate of creation is so slow that soil should really be treated as a non-renewable resource. Peats are also created at a rate so slow as to be non-renewable. Furthermore, drainage associated with afforestation or peat extraction in a bog may change the hydrology and cause decomposition rather than formation of peat.⁶³ (As peat is a very different type of substrate, much of this discussion is confined to problems on mineral soils.)

⁶¹ See Jenny (1994).

⁶² See, for example, Moles and Moles (2002).

⁶³ See Holden *et al.* (2007).

Mineral soils are created over time by the weathering of rocks or other parent material, such as glacial deposition and by plants. The organic material returned by plants to the soil above and below ground adds nutrients and provides food for a myriad of litter and soil organisms. Climate, such as rain leaching iron or clay, acting over time creates horizons or layers in mineral soils, by which soils are typically classified. However, other aspects of the soils, such as physical structure and mineral texture, can be as or more important than soil classification in affecting the vegetation which might grow on that soil type. Some heavy-textured soils, for example, can retain water for long periods, leading to the development of wet-loving vegetation on hillsides and slopes but without development of dominant reduction-oxidation features which would determine the classification as a gleysol. These heavy soils are often also vulnerable to erosion by water if exposed.

Organic soils behave differently from mineral soils, with their lack of internal structure as well as waterholding capacity. However, even what may appear to be a fairly uniform vegetation in uplands is a mosaic of habitats created by underlying topography, additional subsurface deposits such as glacial and alluvial deposits, and lateral water movement.

Land use can have dramatic effects on soil properties. For example, subsoil compaction due to poaching in wet weather has been shown to contribute to flooding in Wales⁶⁴. Past land use has been shown to have effects on soils noticeable even thousands of years later, whether through erosion⁶⁵ or changes in soil chemistry⁶⁶. Seventeen percent of the land area across the globe has been degraded by erosion, compaction, nutrient decline, pollution, soil sealing, and other damage, according to the ISRIC World Soil Information⁶⁷. In addition, soil degradation can interfere with other ecosystems, such as siltation of rivers in Ireland.

Forest operations can have negative impacts on the following properties of mineral soils:

1. Organic matter content, which is related to soil fertility, resistance to acidification, soil biodiversity, and vulnerability to erosion.
2. Soil physical structure, which can be damaged through compaction by heavy machinery (reduced but not eliminated by the use of brash mats). This is related to soil's water-holding capacity, and the impact of damage could be exacerbated by predicted drier summers and wetter winters. (This is also a major factor on organic layers of soils, such as peaty upper horizons or deep peats.)
3. Repeated cycles of monoculture plantations followed by clearfelling, especially those established with the aim of maximising rapid growth of young trees, may result in soil nutrient depletion and changes in soil pH.
4. Forestry operations can accelerate erosion during forest establishment, road construction, harvesting and replanting.

Some of these problems are inherent in any production systems, whether agriculture or forestry⁶⁸. Soil cultivation always reduces soil fertility, as nutrients are taken up by the plants and then exported when they are harvested. Organic matter is needed in the soil to contribute to the ability of the soil to hold water in dry periods as well as for reasons for nutrient supply. The addition of fertilisers ameliorates the loss of nutrients. However, fertilisers can cause problems as well, by entering waterways or altering existing terrestrial plant communities. In Britain, research has shown that addition of fertilisers and associated drift has resulted in loss of some plants preferring infertile soils, resulting in a reduction in

⁶⁴ Clarke 2006

⁶⁵ Edwards and Whittington (2001)

⁶⁶ Cunningham *et al.* (1999), Dupouey *et al.* (2002), Holden *et al.* (2007)

⁶⁷ <http://www.isric.org/UK/About+Soils/Introduction+to+Soils/>

⁶⁸ Much of the following is based on World Soils Information summary (website as above).

national biodiversity. Dead wood left on site on forest harvesting sites helps support not only the soil biota⁶⁹ but also to maintain a pool of nutrients on site.

The EPA⁷⁰ describes soils in Ireland as being of good quality but under increasing pressure. The factors causing pressure on soils and soil quality in Ireland are: land use changes, intensification of agriculture, erosion and overgrazing, disposal of organic wastes to soils, industry and urbanisation, and afforestation. The threat of afforestation, especially by conifers, is based on the fact the many plant nutrients are positive and basic ions. As these are taken up by the newly planted trees, the soil naturally becomes more acidic. This problem is worse where the trees are grown vigorously and then harvested at a young age and the nutrients taken off site with the timber. Acidification is also more of a threat on base-poor geology, which has little capacity to buffer or absorb the impact of increased acidification. Acidification of soil water can result in acid impact on waterways, which is one of the reasons buffers are considered beneficial to aquatic ecosystems.

Road building, removal of tree canopy at harvest, machine traffic, drainage, and disturbance of the litter layer all contribute to erosion. Soil erosion is a problem because soil is lost at source. On shallow soils, erosion can expose bare rock, and the soil and related organic matter will enter water courses. Both of these processes can cause siltation, and organic matter can also cause eutrophication and reduce the concentration of dissolved oxygen.

Summary of threats of plantation forestry to soils in Ireland (from Brogan et al. 2002: p29).

Stage in forestry cycle	Forestry practice and tree development	Impact on soil	Other impacts
Establishment Years 0-5	Ground preparations including drainage and cultivation and road construction	<ul style="list-style-type: none"> • Soil erosion • Increased organic matter decomposition • Increased biological activity causing the formation of organic acids • Soil compaction 	<ul style="list-style-type: none"> • Increased sedimentation in water courses alter flow regime in water courses • Increase nitrate leaching and phosphate runoff to watercourses • Loss of indigenous vegetation
Mid-rotation Years 5-30	Impacts of trees at canopy closure include acidification and water interception. Thinning operations, road and drainage maintenance.	<ul style="list-style-type: none"> • Filtering of air pollutants by canopy resulting in increased rate of acidification of soils • Conifer needles add to soil acidity • Soil erosion during construction of roads and rides • Loss of organic matter • Altered soil structure and soil fertility 	<ul style="list-style-type: none"> • Acidification of watercourses • Reduced soil pH increases mobility of toxic elements e.g. Al³⁺ to aquatic ecosystems • Sedimentation of watercourses • N and P losses to water • Reduced water quantity • Increased shading reduces habitat diversity

⁶⁹ Soil biodiversity could be essential in helping an ecosystem recover from stress such as climate change (Brussaard *et al.* 2007)

⁷⁰ Brogan *et al.* 2002.

Stage in forestry cycle	Forestry practice and tree development	Impact on soil	Other impacts
Harvesting Years 30 plus	Removal of vegetation cover Tree felling, removal and transport of timber	<ul style="list-style-type: none"> • Soil erosion of bare soils • Damage to soil structure • Soil compaction loss of organic matter • Reduced soil fertility reduced soil buffering capacity as cations removed in biomass harvesting 	<ul style="list-style-type: none"> • Sedimentation of water courses • Increased nitrate leaching • Increased surface water runoff • Loss of diversity in aquatic ecosystems Reduced soil pH increases mobility of toxic elements e.g. Al³⁺ to aquatic ecosystems

On the other hand, trees, with their relatively deep roots⁷¹, can have beneficial effects on the physical properties of soils, including their structure, bulk, density, porosity and water retention⁷². Tree canopies intercept rain and slow its passage to the ground and through the soil, into watercourses. Tree and other plant roots help improve the percolation of the water, reducing the risk of surface erosion. They also use a large percentage of the water falling as precipitation, especially in climates with wet and dry periods⁷³, as is expected to become more normal in Ireland with climate change. This 'sponge' effect of forests is greatly influenced by management. It is possible that the recent landslides on mineral soils in the Leenaun valley could have been mitigated if trees were growing on the mineral soils on some of the hills. Forests have long been associated with an ability to slow down run-off and reduce downstream flooding, especially forests which straddle the width of a flood plain⁷⁴. The impact of trees on soils and water depends on the soil, the site, and the tree species.

⁷¹ But see Crow (2005) for a discussion of actual root depth

⁷² See van Dijk and Keenan (2007)

⁷³ Andréassian (2004)

⁷⁴ Nisbet (2001)

Glossary

Abundance: the amount of each species present at a site.

Afforestation: the planting of trees in an area that has lacked forest cover for a very long time or has never been forested.

Agroforestry: the intimate integration of forest and some form of agricultural production.

Allochthonous detritus: organic matter found in waterways deriving from outside, non-stream sources.

Amenity: a two-fold definition used to indicate non-timber uses of forest, generally meaning recreation and contribution to landscape. It is an unsatisfactory term because it is vague and each of the component functions has different implications for management.

Ancient woodland: a woodland that originated before a threshold date, generally taken for convenience as AD 1600, because in Britain maps first become available and plantation forestry becomes important from that date. In Ireland, the first systematic mapping of the country was carried out in the 1830s and 1840s.

Aquatic biotopes: the combination of the physical habitat and its recurring community of animals and plants in aquatic habitats.

Basal area: the cross-sectional area of a tree measured at 1.3 m (breast height) from the ground, or the sum of the basal areas of trees in a specific area, expressed in m².

Beating up: the replacement of transplanted trees which have died. (synonym: filling in)

Biodiversity: the variety of all life forms at all levels including genetic diversity, species diversity and landscape diversity within an ecosystem.

Boreal forest: the northern forest (of the god Boreas), found in Alaska, most of Canada, Scotland, Scandinavia, and Siberia. Limitations on tree growth in the boreal zone are a short growing season, heavy snow cover, and sometimes peaty soil. Boreal trees imported into the temperate zone often grow faster than temperate trees, and thus are often used for commercial forestry, but may have difficulties with the lack of definite end to winter, for example, for flushing.

Brashing: the removal of lower branches up to a height of about 2 m to facilitate access for inspection, thinning or other purposes.

Brash mat: a soil protection measure using in harvesting operations consisting of putting harvesting residues over areas where heavy machinery is going to travel.

Broadleaf (woodland): broadleaved trees are angiosperms, in contrast with the gymnosperms, primarily represented by conifers. They tend to have leaves broader than the typical linear leaves of conifers. The use of this term groups holly and other broadleaf trees that keep a leaf cover all year (i.e. evergreen), with other angiosperms, while larch and other conifers that lose their leaves at certain times of year (i.e. deciduous) are grouped with other conifers.

Bryophytes: a group of plants including mosses and liverworts that reproduce using spores; with no vascular system, they can only grow up to a few centimetres in height and thus comprise only the lowest layer in the woodland strata.

Buffer zone: an area adjacent to an aquatic zone and managed for the protection of water quality and aquatic ecosystems.

Buffering capacity: capacity of water or soil in a natural solution to resist changes in pH which would otherwise result from input of a certain amount of an acid or base.

Calcareous soil: an alkaline soil which contains free calcium carbonate.

Canker: dead area of a branch or stem caused by fungal or bacterial attack.

Catchment: a water catchment is an area from which a river or lake derives its water. Synonyms are drainage basin and watershed. Catchment-based management planning takes the entire aquatic network into account.

Certification: a voluntary, market-based instrument aimed at promoting sustainable forest management that takes into account environmental, economic, and social issues. It involves an independent assessment of forest management according to internationally or nationally accepted standards, and the tracking and monitoring of the supply of forest products to the market place.

Chain of custody: the process of monitoring the production and distribution of goods from the forest to the end-product (i.e., tracing the origin of the product).

Clearcutting (synonym: clearfelling): involves harvesting trees of all sizes over a considerable area, a method frequently used with plantation monocultures (Packham et al. 1992: 29); the new forest is regenerated without any shelter from the old canopy and often by planting. The cutting down of all trees on an area of more than 0.25ha.

Climate change: “the long-term fluctuations or trends in temperature, precipitation, wind, and all other aspects of the earth’s climate” (Helms 1998: 31).

Close-to-nature forestry: a general term encompassing a number of silvicultural systems where the forest is managed in an integrated way in conjunction with the natural processes and dynamics of the forest ecosystem. This could include continuous cover forest management, coppicing and low impact systems, amongst others.

Conifers: a grouping of trees and shrubs (botanically known as gymnosperms) with needle or scale-like leaves (e.g. pine, spruce, cypress) and bear cones. Most conifers are evergreen. They provide softwood timber.

Conservation: the wise use of resources.... involves attitudes of mind (Hookway and Davidson 1970: 2) or “protection against undesirable changes” (De Groot 1992: 308). In contrast with **preservation** (“keeping something in its present state” (IUCN, UNEP, and WWF 1991 in De Groot 1992: 308).

Continuous Cover: use of a silvicultural system whereby the forest canopy is maintained at one or more levels without clear felling

Coppice system: Trees felled close to the ground so as to produce shoots from the resulting stools, giving rise to successive crops of poles and sticks cut over a rotation. Many species are effectively rejuvenated by this treatment. Coppicing can only be used with broadleaved trees as most conifers have fewer dormant buds and do not sprout from stumps. (See also POLLARD).

Coppice with standards: a coppice system in which some poles are left at each harvest, allowing growth of larger-diameter timber and some retention of the forest microclimate.

Coppicing: Cutting a coppice.

Coupe: A felling area, usually one of an annual succession.

Crown thinning (approximate synonym: halo thinning): The removal of selected trees in the upper canopy to allow growing space for the remaining trees.

Crown: Spreading branches and foliage of a tree.

Cultivated: considerable alteration to physical or chemical properties of the soil or vegetation by agricultural use.

DBH: Diameter breast height - diameter of the stem measured at 1.3 m above ground level (mean diameter is the quadratic mean, the diameter corresponding to the mean basal area tree).

Decay: the decomposition of wood resulting from the action of wood-rotting fungi in damp/wet conditions; results in loss of strength and weight, generally with a change in texture and colour.

Deciduous: the shedding of leaves at the onset of a dormant period (winter in the temperate zone). Most broadleaves are deciduous, whereas only some conifers are deciduous, e.g. larch.

Density: the number of individuals of a particular species per unit area.

Designation: the act of officially identifying a site as important. For example, legislation protects sites that have been designated as SAC (Habitats Directive), SPA (Birds Directive), or NHA (national designation).

Digital elevation models, or digital terrain models (DEMs or DTMs): GIS raster datasets in which each cell has a value of elevation. These can be used to model the topography of the landscape.

Disturbance: a disruption of the ecosystem that changes resources, substrate availability, or the physical environment and opens up space that can be colonised by individuals of the same or different species. In a natural system, disturbances result in re-creation of early successional or pioneer stages.

Dominant trees: the tallest and most vigorous trees in a stand, which usually have a large proportion of their crowns free of competition.

Ecology: the scientific study of the processes influencing the distribution and abundance of organisms, the interactions among organisms, and the interactions between organisms and the transformation and flux of energy and matter.

Ecosystem: a community of organisms, interacting with one another, plus the environment in which they live and with which they also interact; e.g. a pond, a forest. The system consists of producers, consumers, and decomposers. The latter break down dead organisms, absorb nutrients for growth and release nutrients to environment for use by producers. All of these activities are affected by physical conditions of environment.

Edge effect: The modified environmental conditions or habitat along the margins (edges) of forest stands or patches.

Elm decline: Drop in levels of elm pollen about 5900 years ago; may have been due to climate, human factors such as clearance for tillage and use of elm as an indicator of good soil, an outbreak of Dutch elm disease (a chronic epidemic caused by the fungus *Ophiostoma novo-ulmi* spread by *Scolytus* beetles), or perhaps severe pruning to provide fodder for livestock. However, Rackham (1980 in Groenman-van Waateringe 1983: 218) found that pollarding of such proportions would keep 500,000 adults occupied full-time for the entire summer.

Enclosed land: land that was enclosed and improved for agricultural use by cultivation or manuring or both, and which is completely surrounded by man-made boundaries.

Erosion: The movement of soil and rock material by agents such as running water or wind.

Epicormic (branches): Small branchlets (shoots) originating from adventitious buds on the stem.

Establishment (of a forest): a stage when trees dominate the ground vegetation.

Even-aged silvicultural system: a silvicultural system that is designed to regenerate and maintain an even-aged stand. Clearfelling, coppicing and uniform shelterwood are even-aged systems.

Exotic species: a species that is introduced to a particular place by humans; a non-native species.

Extraction: the operation of removing felled timber from the forest to a road accessible by lorry.

Felling coupe: an area proposed for felling in one operation.

Filling in: see 'beating up'.

Final crop: the trees which remain after successive thinnings and are finally felled at maturity.

Fire break: fire line or fire belt. Strip of land where vegetation has been removed to assist in the prevention of fire entering a forest. Usually 6-7m. wide

Flushing: The commencement of growth of a plant above ground characterised by sap flow and swelling and bursting of buds.

Foliar sampling: the taking of samples of leaves or needles to determine nutrient levels and consequently determine fertiliser requirements.

Forest: areas of land where species of tree occur and give at least 60% coverage. This proportion may be temporarily smaller, i.e. when a stand is not fully grown.

“a certain territory of woody ground and fruitful pastures, privileged for wild beasts and fowls of the forest, chase and warren, to rest and abide in, in the safe protection of the king, for his princely delight and pleasure, which territory of ground, so privileged is meered and bounded with unremovable marks, meers and boundaries, either known by matter or record, or else prescription.... And therefore a forest doth chiefly consist of these four things, that is to say, of vert, venison, particulars and privileges, and of certain meet officers appointed for that purpose, to the end that the same may be better preserved and kept for a place of recreation and pastime meet for the royal dignity of a prince.” (John Manwood, 1598, A Treatise of the Laws of the Forest, quoted in Neeson 1991: 37).

Forestry: management for human benefit of the natural resources that occur on or in association with forest lands, whether existing forest or plantations.

Forest species: a plant or animal that is dependent on a forest for part or all of its life cycle. A forest specialist is a forest species which requires forest as a habitat and cannot adapt to other habitats, such as the shade of deep ditches or hedgerows.

Forwarder: usually an eight wheel drive or tracked vehicle capable of extracting timber over rough terrain.

Freshwater pearl mussel: *Margaritifera margaritifera*, a freshwater mussel found in Irish rivers and protected under the EU Habitats Directive. A second species, *M. durrovensis*, is only found in the River Nore.

Frost damage: damage to the soft tissues of trees by cold temperatures, which can occur in the nursery and in young plantations. Trees are most vulnerable when freshly flushed in late spring or early summer and again in autumn prior to "hardening off".

Fungus: a mushroom, toadstool or one of the similar plants such as mould. Fungi have no chlorophyll and obtain food from living and dead organic matter. Some fungi form mutualistic partnerships with plant roots (mycorrhizae) or algae (lichens).

Geographic Information Systems (GIS): a set of spatial databases. GIS often refers to the manipulation, interpretation, and cartographic display of these databases. The data may be derived from remote sensing such as aerial photographs, from field surveys, or from other sources.

Habitat: any place or type of place where an organism or community of organisms normally lives and thrives.

Habitats Directive: more formally known as Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora; a European Union Directive adopted in 1992 as an EU response to the Berne Convention. It is one of the EU's two directives in relation to wildlife and nature conservation, the other being the Birds Directive.

Hardwood: timber of broadleaved trees; the term relates to the botanical grouping of the trees and not to the hardness of the wood (some hardwoods, e.g. balsa, are softer than softwoods).

Heartwood: wood of the inner growth rings, extending from the pith to the sapwood; no longer participating in the life processes of the tree. The starches are depleted and often replaced with resins and other substances which may make the wood darker and more decay resistant.

Hectare: metric unit of area equal to 100 m x 100 m, 2.471x larger than an acres. This means that the number of acres divided by 2.471 equals the number of hectares. Abbreviated ha.

Herbivore: animal that consumes parts of a plant, including leaves and other parts. Applicable to invertebrates as well as larger animals.

High forest: woodland which is not managed as coppice or pollards and which may or may not be managed for timber.

Indurated soil: has strongly compacted material, which is low in organic matter. It normally occurs at depths of 30-75 cm and extends for 30-50 cm or more.

Infiltration: downward movement of water (from precipitation) into the soil.

Interception: capture of precipitation by vegetation, from which the water generally evaporates.

Interpretation: explanation of the meaning or significance of something, such as natural history and the role and place of people in the environment. The objective is to give a fuller understanding so as to ensure a better appreciation and enjoyment of an area or feature by describing and explaining it in non-technical language.

Invasive (plants and animals): A plant or animal that is not native to an area but is now established and expanding at the expense of native plants or animals.

Irregular shelterwood: a silvicultural system which involves the canopy being removed over successive regeneration fellings over a long period and which provides relatively uneven-aged regeneration and irregular structure.

Juvenile wood: wood formed in the vicinity of the tree core under the live crown; (which gradually moves up the tree as trees grow and competition ensues) taken to be the first 12 years from the pith for Sitka spruce).

Knot: the portion of a branch that has been surrounded by wood in the subsequent growth of the stem. One of the objectives of pruning is to produce timber with fewer dead (loose) knots.

Landscape: often used to mean the view or scene; also refers to the complex of an area: geology, topography, vegetation, buildings and other human-created patterns such as fields and roads.

Landscape scale: areas greater than 1 km² - e.g. river catchments.

Leisure: the time available to us when the disciplines of work, sleep and other basic needs have been met (Hookway and Davidson 1970: 3).

Lichen: a cooperation of a fungus and an alga growing together.

Light demanders: refers to trees which only thrive when allowed unimpeded access to light.

Litter: organic matter deposited from nearby plants.

Live crown: The length, or depth of crown between the top of the tree and a point mid-way between the first live branch and the first full live branch whorl.

Long term rotation (LTR) or long rotation stands: Stands retained beyond the normal economic felling age (40 - 80 years), but which will be felled at some time.

Lop and top: woody debris from thinning or felling operations. Also known as slash or brash.

Low-impact silvicultural systems: Silvicultural systems including continuous cover forestry, selection system, shelterwood, or underplanting, small coupe felling, coppice or coppice with standards, minimum intervention and single tree selection systems.

Marl: soft calcium carbonate, usually mixed with clay.

MMAI: Maximum mean annual increment, it is the point at which the maximum average rate of volume increment that a particular forest can achieve is reached.

Mean Annual (volume) Increment: The average (volume) increment over the rotation, calculated as the total volume production divided by the rotation age.

Mid-successional stands: stands which have passed the establishment phase, but are not ready to be felled; a typical range of ages would be 20 - 50 years.

Minimum intervention: relating to stands where there are negligible management inputs, and practices such as felling, thinning and restocking do not take place.

Monocultures: an area of forest in which only one species is present or largely dominates.

Mor humus: has a high C/N ratio (around 20) and is of low fertility; frequently develops under conifers and under oak or beech on acid soils poor in bases. It has thick litter and fermentation layers, is generally not digested by earthworms or other large soil fauna, and has a pH of between 3.0 and 6.5 (Packham et al. 1992: 104).

Mounding: formation of discrete heaps of soil, usually 20-30cm in height, at the intended planting spacing.

Mull humus: is more decomposed, primarily by soil macrofauna, and has a pH of between 4.5 and 8, with a C/N ratio of about 10. It forms under deciduous or mixed forests on moderately well-drained calcareous soils, although it can also develop under cedar or under spruce with a high calcium litter percentage (Packham et al. 1992: 104).

Multi-functional (multiple-use) forestry: management of forests fulfilling two or more objectives of management. Multiple functions may be integrated at one site or segregated from each other.

Mycorrhiza: a fungus living in symbiosis with plant roots.

Native (to a place): a species of plant or animal that was not brought to a site by humans. A species that would grow naturally on the site under consideration; within its natural geographic range and normal soil conditions (Peterken 1996: 16).

Native woodland: Woodlands composed of site native and locally native tree and shrub species.

Natura 2000: An ecological network in the territory of the European Union of habitats and species protected under the Habitats Directive (SACs) and areas protected for birds under the Birds Directive (SPAs).

Natural disturbance: disruption to forest stands, vegetation and wildlife by a natural event such as strong wind, fire or grazing.

Natural Heritage Areas (NHA): areas designated or proposed for designation by NPWS as national areas of nature conservation interest and protected under the Wildlife Act. The process of NHA designation is ongoing.

Natural regeneration: regeneration of trees from seed produced by trees in the vicinity.

Nature trail: a marked walk along which signs are provided giving information on the flora and fauna in the area (forest or nature reserve) with the aim of arousing interest in them (Heytze 1980: glossary 8).

Niche: a particular role (or set of relationships) of organisms in an ecosystem, which may be filled by different species in different geographical areas (Abercrombie, Hickman, and Johnson 1973: 196).

Non-timber forest products: All forest products except timber, including other materials obtained from trees such as resins and leaves, as well as any other plant and animal products.

Nurse species: Tree species which enables more delicate or more site demanding species to grow satisfactorily on what would otherwise be considered unsuitable sites.

Nutrient run-off/eutrophication: nutrient enrichment in aquatic ecosystems.

Off-site: planted trees which are growing on a site which differs from the specific site that species prefers.

Open grown: the form of trees grown in the absence of competition and shading.

Parkland: a forest habitat made up of widely spaced trees over grassland. The trees are able to develop large crowns and may be rich in lichens due to the high light levels.

Peat: organic soil made up of plant parts.

Pesticide: something which kills a pest, defined as an animals that consumes or damages materials intended for human use. Pesticides are a type of biocide, a larger category which includes herbicides (killing plants) and fungicides (killing fungi).

pH: A value on a logarithmic scale of 0-14 that gives a measure of the acidity or alkalinity of a soil. A neutral soil has a pH of 7. Soils range from over 3 to under 9 in pH. The lower the pH the more acidic is the soil; the higher the pH the more alkaline. pH interacts with plant nutrients, so a soil with a lower pH tends to have fewer available plant nutrients.

Pioneer species: tree species that colonise open habitats. Birch are considered to be pioneer tree species.

Podsol: soil type developed in light textured (sandy) material under acid conditions by downward leaching of organic matter, and iron and aluminium oxides, giving rise to a greyish (bleached) surface layer underlain by a darker layer. In extreme cases these layers may be separated by a root- and water-impenetrable hard-pan (e.g. Ballyhoura).

Pollard: a tree cut 2-4m above ground level, producing a crop of branches which can be harvested in subsequent years.

Potential natural vegetation: the habitat which would be present on a site if humans had not intervened in succession. PNV is estimated from soils, climate, and remnant vegetation.

Precautionary principle: if any action is thought possibly to be damaging, one must first prove it will not cause harm before being able to engage in that action.

Provenance: origin of seed; i.e. from the population of which (denoted by geographical location) it is derived.

Pruning: The removal of branches in order to maintain a single central leader, repair storm damage, or promote clear stems for eventual production of high grade timber.

Pulpwood: logs suitable for processing into fibreboard, chipboard, etc. with small-end diameter between 7 and 14 cm.

Rainforest: a forest community associated with continual high humidity and precipitation. Forests on the west of Ireland are temperate rainforests.

Raptor: generic term for birds of prey, including hawks, eagles, falcons, osprey, and owls.

Recent woodland: woodland which originates after the threshold date set for ancient woodland, generally 1600 CE (Peterken 1993: 12).

Recreation: any activity or experience undertaken or undergone in a person's free time voluntarily and without restraint but subject to the social order with the purpose in the first instance of obtaining satisfaction and pleasure; recreation fulfills at least one of three functions: it provides relaxation; entertainment; and a means for personal and social development.

(Natural) Resource: any element of the natural environment considered to be of value to humans.

Reforestation: replanting of an area on which the previous crop of trees has been harvested.

Resilience: ability of an ecosystem or organism to recover from a stress after being impacted.

Resistance: ability of an ecosystem or organism to withstand being affected by a stress.

Restocking: the practice of replanting after a stand of trees that has been felled.

Retention: stand retained beyond normal economic felling age (40 - 80 years) which will usually remain in perpetuity.

Ride or ridelines: unplanted strips between stands, used as firebreaks and access routes.

(species) Richness: the number of species present on a particular area.

Rock phosphate: common type of fertiliser used in forestry, usually at the establishment stage to encourage tree and more specifically root growth.

Rotation: the period in years required to establish and grow a crop to a specified condition of maturity, at which stage the crop is felled or regenerated.

SAC: Special Area of Conservation, designated under the EU Habitats Directive 1992 (EC directive 92/43).

Saproxyllic: organisms that depend on wood, usually but not always dead wood, for some part of their life cycle.

Sawlog: logs, usually of at least 14 cm top diameter, which are intended for conversion in a sawmill.

Scarification: removal of vegetation to expose mineral soil for tree planting.

Scrub: early successional woodland, usually made up of multitemmed and other trees in the thicket stage or early pole stage. In Ireland, common species are hazel, blackthorn, hawthorn, and ash.

Secondary woodland: woodland which came into existence on land which, though it may have been wooded in prehistoric times, was at some time clear of trees.

Selection system: a silvicultural system in which felling and regeneration are distributed over the whole stand and over time. Trees are usually removed individually over the course of a felling cycle, regeneration is usually natural and the trees are of different ages.

Semi-natural woodland: a general term used to denote woodlands that have been modified by human activities but have some natural characteristics. As very few forests do not show evidence of both natural processes and human impact, this term is very broad.

Sustainable Forest Management: "The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality, and their potential to fulfil, now and the future, relevant ecological, economic, and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems" (EC 2006: Annex p4).

Shelterwood system: a stand of old trees is harvested in several stages over 10 to 30 years, allowing the old stand to provide seed and shelter the early stages of the new trees, and (Hart 1995: 3). The group shelterwood system is centered around several small patches which are cut at first and which gradually grow outwards, and strip and strip-and-group shelterwood system are similarly explained in their names (Hart 1995: 3).

Silt trap: helps to prevent silt entering rivers and streams and is constructed by deepening mound drains to 1 m x 1 m x 1 m. Water entering a silt trap will stagnate and the silt will be able to settle before the water flows out.

Silviculture: the science of forest establishment, maintenance and management.

Skidder: a tractor which extracts timber by dragging it along the ground.

Snag: standing dead tree.

Softwood: timber of conifer trees; the term relates to the botanical grouping of the trees and not to the hardness of the wood (some softwoods, e.g. yew, are harder than some hardwoods).

Soil reaction: denotes soil pH. Thus, acid soils would be described as having an acid reaction.

SPA: Special Protection Area for birds, designated under the EU Birds Directive.

Stand: A group of trees growing together and of similar age.

Stress: an external constraint on an organism which limits growth, reproduction, or resource acquisition. For a tree, stress tends to reduce photosynthesis and growth. Pollution, being off-site, and other environmental factors capable of inducing a potentially injurious strain are stresses for trees.

Structure: composition, abundance, spacing, and other attributes of plants in a community.

Structural diversity: variability in the structure of forest stands attributable to tree size, shape, density and distribution.

Sub-dominant trees: trees are not in the upper crown but the leaders of which still have free access to light.

Suckers: new shoots produced from the base or under ground roots of an established plant.

Succession: the replacement of one kind of community by another kind; the progressive changes in vegetation and in animal life due to natural changes such as colonisation of grassland by scrub followed by the development of high forest.

Suppressed trees: trees whose leaders have no direct access to light and stand beneath the crowns of adjacent dominant, co-dominant and sub-dominant trees.

Temperate forest: forest growing in geographic regions with moderate temperatures and generally four distinct seasons. European temperate forests are generally broadleaf; higher latitudes and altitudes alter the tree composition to boreal or alpine. Tree refugia and recolonisation during climate changes over hundreds of millennia has resulted in a diversity of conifers in the Northwestern American temperate forest.

Thicket stage: stage after planting and before pole stage when young trees have grown up enough to form a dense thicket; when branches of the young trees grown together and dominate the site.

Thinning: the removal of a proportion of trees from an immature crop in order to improve the growth and form of the remainder; removal of some trees to allow the resources of the site go into others. Thinning can be by selection, requiring skill to select and mark the trees, or systematic, in which every xth line is removed. Crown thinning is removal of neighbouring trees to allow the best crop trees to develop.

Thinning cycle: The interval in years between successive thinnings.

Transplant: in a forest nursery seedlings are normally transplanted after one or two years in the seedbed so as to develop a better root system and a sturdier plant.

Unenclosed land: Land that shows no evidence of having been improved and enclosed by man-made boundaries for agricultural use other than extensive grazing. Roughly equivalent to peatlands (heath and bog).

Uniform shelterwood: A silvicultural system which involves uniform opening of the canopy to provide uniform and relatively even-aged regeneration

Value: “standards or criteria which guide action as well as other psychological phenomena such as attitudes, judgements and attributions. Values are considered deeper and more stable than attitudes, representing standards of ‘oughts and shoulds’, and are viewed as determinants of attitudes” (Rokeach 1979: 272 in Axelrod 1994: 86).

Windfirm: Descriptive of trees and plantations that, because of species, soil or relative exposure, are unlikely to suffer windthrow; Trees that are unlikely to blow over when exposed to strong winds.

Windthrow: Uprooting or breakage of trees caused by strong winds; partial or complete overturning or breakage of trees.

Whole-tree harvesting: Removal of the entire tree from the harvest site, including branches and bark.

Wolf tree: dominant, defective trees with large crowns and / or large side branches, which can interfere with adjacent trees if not removed.

Wood Pasture: grazed woodland characterised by open growth (often pollarded) veteran trees at various densities.

Working Circle: a forest area with a particular objective, under one silvicultural system and having one set of working plan prescriptions.

Yield class: a classification of rate of growth in terms of the potential maximum mean annual increment per hectare of volume to 7 cm top diameter ($m^3/ha/annum$), irrespective of age of culmination, or of tree species.

Yield Table: a tabular statement of the development of a stand, at periodic intervals, from early youth up to a certain age usually a full rotation.

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