The Classification of Native Woodlands in Ireland and its Application to Native Woodland Management

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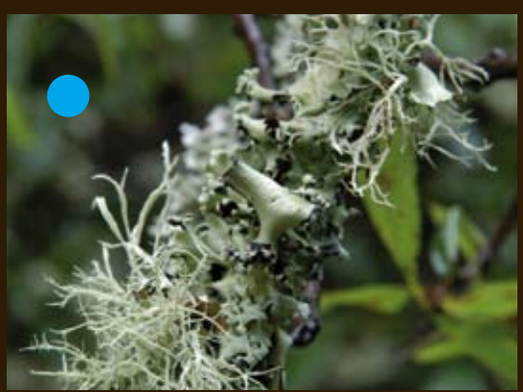

Native woodlands vary considerably with respect to species composition, depending on climatic and site conditions, particularly soil and elevation. This gives rise to different woodland assemblages or communities, some of which are very distinctive. The classification of native woodlands is not only an indicative guide to the variety and diversity of native woodland communities that exist in any given region, but can also be an essential tool in the management and expansion of native woodlands. In any native woodland management project and during the application of the Forest Service Native Woodland Scheme (NWS), woodland classification is a critical component at the planning stage by

- enabling the identification of the most appropriate woodland community type(s) within an existing woodland, which can then be promoted through appropriate management; or
- providing guidance regarding the most appropriate native woodland type(s) that should be established on a greenfield site, subsequent to the verification of on-site parameters, including soil type, topography, altitude, aspect, local climate and current vegetation.

Therefore, this Information Note is relevant to those with an interest in Ireland's native woodlands, particularly practitioners involved in their management.

The classification system presented is also highly relevant to landowners, foresters and ecologists involved in projects under the NWS, as it replaces the classification system set out in Appendix 7 of the Native Woodland Scheme Manual (Forest Service, 2008). As such, native woodland plans developed under the NWS must utilise the classification system set out in this Information Note when identifying the native woodland type(s) to be promoted. **Please note, the inclusion of any particular native woodland type within this updated classification system *does not* infer that it will be eligible for grant aid under the NWS**.

The classification system set out in this Information Note is based on the recently completed National Survey of Native Woodlands 2003-2008 (Perrin *et al*., 2008), which is the first national survey of the native woodland resource undertaken in Ireland. New information on the variety and types of native woodland that exist in Ireland is included.

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INTRODUCTION

The National Survey of Native Woodlands undertaken between 2003 and 2008 was the first survey of its kind ever undertaken in Ireland. Over 1300 sites throughout the country were examined in detail. At each site, a suite of physical and biological parameters were recorded, including the flora, woodland vegetation type and structure, management and soil. The classification system outlined in this note is largely based on the vegetation and soil data from over 1600 quadrats collected during the course of this survey (Perrin *et al*, 2008). As native woodland classification is an integral part of the planning phase of projects under the NWS, it is appropriate that the findings of this national survey are used to update the classification requirements.

The survey concluded that there are four principal native woodland **types** in Ireland: oak woodlands, ash woodlands, alder woodlands and birch woodlands. These are further divided into 22 **sub-types**. Some of these sub-types represent variations in the soil or hydrological regime while others are a result of past and current management. The variation between some of these sub-types is subtle and may be hard for the non-specialist to recognise. Specifically, variation is typically observed in the ground flora and a detailed knowledge of the range of species that occurs here is required. In addition, two units not described in the National Survey and three scrub types are included in the revised classification.

Background to the revised native woodland classification system

Since the classification system outlined in this Information Note is primarily based on the findings of the National Survey of Native Woodlands, the nomenclature used differs considerably from that used to date by practitioners in the development of NWS plans (i.e. Cross, 2008). The previous system was based on limited and biased data from detailed studies in specific regions. Woodlands in other regions were virtually unknown at that time. The new classification, while not based on exhaustive sampling, is much more comprehensive as data were collected across the whole country from stratified samples based on predetermined criteria ("arbitrary but without preconceived bias"). It closely follows the system used in the British National Vegetation Classification Scheme (e.g. Rodwell, 1991). The woodland types are named using the best indicator species from the tree layer and from characteristic species among the other vascular plants[1]. Sub-types are named using the two best vascular indicator species. To facilitate comparisons with the previous, and other, classification systems, a table showing the relationships and affinities is given in Appendix 1.

The classification system in this Information Note is designed for use in the NWS during the development of the native woodland plan for both Element 1 (Conservation of *existing* native woodlands) **and** Element 2 (Establishment of *new* native woodlands on *greenfield* sites). Its purpose is:

- to aid in the identification of the most appropriate native woodland type(s) to be promoted or reinstated by management of a site, and
- to guide the selection of appropriate species and mixtures for planting on a site in the absence of, or in conjunction with, natural regeneration.

Woodland structure

Woodlands are typically characterised by well-developed layers traditionally referred to as the tree or canopy layer, the shrub layer, the dwarf shrub layer, the herb or field layer and the ground or moss (bryophyte, i.e. nonvascular plants, including the mosses, liverworts, and hornworts) layer. These layers may sometimes be sub-divided into additional layers, e.g. the field layer may have a tall layer of bracken above a lower layer of shorter herbs. Trees and shrubs may occur in several layers depending on their stage of development, while lianes (climbers), such as ivy *(Hedera helix*[2]*)*, may form an important part of the herb layer but also extend into the canopy.

Woodland vegetation is traditionally divided into two major groups: high forest and scrub. The dividing line between these two categories is frequently obscure, particularly as scrub is often a precursor to high forest so that one may merge imperceptibly into the other. Traditionally, however, the height of the vegetation is used to separate the two groups, with 5 m being taken as the upper limit for scrub on dry sites, and 4 m for scrub on wet sites.

1 *Vascular plants – plants that have a specialised conducting system consisting mostly of* **phloem** *(food-conducting tissue) and* **xylem** *(water-conducting tissue), collectively called vascular tissue.* **Ferns**, **gymnosperms**, *and* **flowering plants** *are all vascular plants).*

2 *For nomenclature see classification system description on page 4.*

Factors affecting the woodland vegetation

A variety of factors can determine the woodland vegetation. These include environmental factors such as soil type and climate but also biotic factors and management history. Management can strongly influence both the structure and composition of a woodland and the nature of many stands may be a reflection of a management regime which has long since been abandoned. Many oak woodlands, for example, are the product of past coppicing in which oak was the preferred species, resulting in today's even-aged, mono-dominant stands. On the other hand, the species composition of the tree layer can sometimes be purely a matter of chance, being determined, for example, by the occurrence of a seed year coinciding with clear-felling, windthrow or land abandonment.

Many woodlands around former demesnes are characterised by an abundance of sycamore *(Acer pseudoplatanus)* or beech *(Fagus sylvatica)*, often with a variety of non-native shrubs, some of which may be invasive, e.g. cherry laurel *(Prunus laurocerasus)* and rhododendron *(Rhododendron ponticum)* (see Table 1). Former old woodland sites that have been replaced or underplanted with conifers or non-native broadleaves often retain elements of the former flora, thus giving an indication of the type of woodland which previously existed. In order to identify these it will be necessary to look for scattered trees and shrubs from the earlier stand and to examine the field layer, where it is still present. The amount of native vegetation which survives will depend on the species planted: the native flora often persists more or less unchanged under Scots pine *(Pinus sylvestris)* and larch (*Larix* spp.). In contrast, only fragments of the former vegetation or individual plants may remain under Sitka spruce *(Picea sitchensis)* and other heavy shade-casting trees.

Grazing can profoundly influence both the structure and species composition of a wood. Overgrazing, for example, can prevent the regeneration of trees and shrubs and lead to the absence of a shrub layer and a monoculture of certain herbs or grasses, e.g. woodrush *(Luzula sylvatica)* or ivy. Subsequent cessation of grazing can result in the prolific regeneration and dominance of a single species, e.g. holly *(Ilex aquifolium)*.

Table 1: Notes regarding beech and sycamore

Both beech and sycamore are introduced species which have been widely planted in Ireland for several hundred years. They both regenerate freely and in places they have become an integral part of our woodlands. However, because they are non-native and cast heavy shade, which suppresses the herb layer and regeneration of native trees, they are generally considered undesirable in native woodlands. Nonetheless, individuals or groups of veteran trees may provide valuable habitats for some species, especially epiphytes (i.e. non-parasitic plants that grow on another plant for support) and certain animals, e.g. bats, birds and invertebrates, and it may therefore be desirable to retain some trees within existing woodlands. However, if non-native tree species are retained under the NWS (or indeed any other native woodland restoration project), all associated natural regeneration must be controlled.

Beech occurs on a wide variety of soils but is most commonly found on more nutrient-rich soils. It is strongly associated with old estates, usually occurring on sites that would naturally carry ash-ivy woodland, although it also occurs in oak woods on poorer soil. The shrub and field layers, often poorly developed because of the heavy shade cast by beech, include typical species of ash-ivy woodlands. A variety of introduced species may also be present.

Sycamore occurs on a wide variety of sites but is particularly prevalent on moist, nutrient-rich soils. It is especially common in some stands of ash-ivy woods (also, see Note 1, page 4).

Selection of tree species for planting

The relatively small number of native tree species in Ireland makes the selection of the most appropriate species relatively easy once the soil type, altitude and other edaphic factors have been determined. Variations within the woodland types are principally reflected in the relative proportion of trees and shrubs and, often more critically, in the herb layer. As the NWS is primarily concerned with planting the principal tree species, the exercise is less onerous than may be first thought. It is generally accepted that many of the less common shrubs and trees will gradually arrive into planted native woodlands over time if there is a nearby seed source and the habitat conditions are suitable. This also applies to the more mobile species of the herb layer, although many uncommon species, and even some common ones, find it difficult to colonise new woodlands unaided.

THE NEW NATIVE WOODLAND CLASSIFICATION SYSTEM

The classification system described is arranged under a hierarchy of five major types and their associated sub-types (Table 2). The nomenclature follows Stace (1997) for vascular plants, Smith (2004) for mosses, Paton (1999) for liverworts, and Dobson (2000) for lichens.

Table 2: An outline of the native woodland classification hierarchy described in the text

Major type	Associated sub-types
QL Sessile oak-woodrush *(Quercus petraea-Luzula sylvatica)*	**QL1** Bilberry-holly *(Vaccinium myrtillus-Ilex aquifolium)*
	QL2 Woodrush-broad buckler fern *(Luzula sylvatica-Dryopteris dilatata)*
	QL3 Bramble-hazel *(Rubus fruticosus-Corylus avellana)*
FH Ash-Ivy *(Fraxinus excelsior-Hedera helix)*	**FH1** Wood avens-wood speedwell *(Geum urbanum-Veronica montana)*
	FH2 Pedunculate oak-bramble *(Quercus robur-Rubus fruticosus)*
	FH3 Hazel-wood sorrel *(Corylus avellana-Oxalis acetosella)*
	FH4 Holly-Rowan *(Ilex aquifolium-Sorbus aucuparia)*
	FH5 Beech-cherry laurel *(Fagus sylvatica-Prunus laurocerasus)* **(See Note 1)**
	FH6 Sycamore-hawthorn *(Acer pseudoplatanus-Crataegus momogyna)* **(See Note 1)**
	TC Yew-carnation sedge *(Taxus baccata-Carex flacca)* **(See Note 2)**
AF Alder-meadowsweet *(Alnus glutinosa-Filipendula ulmaria)*	**AF1** Ash-remote sedge *(Fraxinus excelsior-Carex remota)*
	AF2 Alder-bramble *(Alnus glutinosa-Rubus fruticosus)*
	AF3 Grey willow-water horsetail *(Salix cinerea-Equisetum fluviatile)*
	AF4 Hawthorn-herb Robert *(Crataegus monogyna-Geranium robertianum)*
	AF5 Birch-water mint *(Betula pubescens-Mentha aquatica)*
	AF6 Alder-tussock sedge *(Alnus glutinosa-Carex paniculata)*
	AF7 Alder-giant horsetail *(Alnus glutinosa-Equisetum telmateia)*
	SU Almond willow-nettle *(Salix triandra-Urtica dioica)*
BM Birch-purple moor-grass *(Betula pubescens-Molinia caerulea)* (See Note 3)	**BM1** Bramble-broad buckler-fern *(Rubus fruticosus-Dryopteris dilatata)*
	BM2 Bilberry-woodrush *(Vaccinium myrtillus-Luzula sylvatica)*
	BM3 Yorkshire fog-bent grass *(Holcus Canatus-Agrostis capillaris)*
	BM4 Ivy-ash *(Hedera helix-Fraxinus excelsior)*
	BM5 Grey willow-marsh bedstraw *(Salix cinerea-Galium palustre)*
	BM6 Purple moor-grass-tormentil *(Molinia caerulea-Potentilla erecta)*
LW Low woodland/scrub vegetation	**LW1** Blackthorn *(Prunus spinosa) scrub*
	LW2 Hazel *(Corylus avellana)* scrub
	LW3 Juniper *(Juniperus communis)* scrub

Note 1: The non-native species beech, sycamore and laurel are widespread in ash woodlands, sometimes as significant components. Their inclusion in the classification system helps in the identification of the woodland type only and does not indicate that they should be considered desirable species or that they should be retained or planted. On the contrary, management should aim to convert these stands toward the relevant ash woodland type, removing the non-native species in the process.

Note 2: Some of the woodland sub-types are relatively rare, occurring sometimes in a complex or mosaic with other sub-types. These are indicated in pink.

Note 3: Unless otherwise stated, references to 'birch' indicate 'downy birch' *(Betula pubescens)*.

At the end of the description of each vegetation sub-type a list of the most appropriate trees and shrubs to plant is provided (in addition, see Appendix 2). These should be used as guidelines to select appropriate species for the establishment of new woodland or for the management of existing stands, particularly where non-native species are being removed and gaps within the canopy are being created. Species of lesser importance that should be planted only in small quantities are placed in brackets. Where woodlands are unsuitable for planting this is clearly indicated in the text. For the purposes of the NWS, Scots pine *(Pinus sylvestris)* is considered a native species and is recommended for planting in certain situations. Soil type and pH data, most of which are derived from the National Native Woodland Survey (Perrin *et al*., 2008) are also provided as guidance for planting. Specific guidance and details relating to planting mixtures and planting spacing required under the NWS are set out in Section 6 of the *Native Woodland Scheme Manual* (Forest Service, 2008). Further guidance is also set out in other Native Woodland Information Notes, i.e. No. 4: *Native Riparian Woodlands – A Guide to Identification, Design, Establishment and Management* (Little *et al*., 2008) and No. 5: *Establishment, Design and Stocking Densities of New Native Woodlands* (Little *et al*., 2009). Where wood production is also an objective, guidance is available in Joyce *et al*. (1998), Horgan *et al*. (2003) and Little & Cross (2005).

High forest (vegetation dominated by trees greater than 5 m in height)

QL Sessile oak – woodrush *(Quercus petraea – Luzula sylvatica)* woodland type

Oak high forest stands on acidic (pH typically *c.* 4.5), well-drained mineral soils, mostly podzols, in upland areas, frequently on hillsides and valley sides.

These woodlands are characterised by a dominance of oak, mostly sessile oak *(Quercus petraea)* but sometimes pedunculate oak *(Quercus robur)* or the hybrid *(Q. x rosacea)*, often with downy birch and rowan *(Sorbus aucuparia)*. Typically, holly forms the understorey and/or the shrub layer. Rhododendron is often abundant, especially in areas of high rainfall. A dwarf shrub layer of bilberry *(Vaccinium myrtillus)* and sometimes ling heather *(Calluna vulgaris)* is typically present. The herb layer is usually species-poor and often dominated by woodrush with abundant ferns, e.g. hard fern *(Blechnum spicant)*, common polypody *(Polypodium vulgare)* and bracken *(Pteridium aquilinum)*. Honeysuckle *(Lonicera periclymenum)* and ivy are often present. Some of these woodlands, especially in the west and in sheltered humid sites elsewhere, are noted for the richness and luxuriance of the mosses, liverworts and lichens.

QL1 Bilberry-holly *(Vaccinium myrtillus – Ilex aquifolium)* sub-type

High oak forest stands on very acidic, strongly-developed podzols (pH 4.3). The canopy is dominated by sessile oak with holly in the understorey. Bilberry characteristically forms large shrubby patches. In the field layer bramble *(Rubus fruticosus)*, ivy and woodrush are frequent, but none of these species is abundant. Other field layer species include honeysuckle, wood sorrel *(Oxalis acetosella)* and ferns such as hard fern, broad buckler-fern *(Dryopteris dilatata)*, hay-scented buckler-fern *(Dryopteris aemula)* and bracken. Polypody is a frequent epiphyte on the branches of mature oaks. Typically however, the number of vascular species is low with much of the species richness being contributed by the bryophytes and lichens, which can be abundant and often present as epiphytes. The chief species are *Thuidium tamariscinum, Hypnum cupressiforme, H. andoi, Isothecium myosuroides, Kindbergia praelonga, Rhytidiadelphus loreus, Polytrichastrum formosum, Mnium hornum, Plagiothecium undulatum, Dicranum scoparium* and *Lophocolea bidentata*.

Most appropriate tree species to plant: Sessile oak, birch, Scots pine, holly and rowan.

QL2 Woodrush – broad buckler fern *(Luzula sylvatica – Dryopteris dilatata)* sub-type

Occurring frequently on very podzolised soils (pH 4.4), the key characteristic of these stands is the carpet of woodrush which may occupy extensive areas of the woodland floor. Bramble and ivy are frequent but are not dominant, while broad buckler-fern and honeysuckle are relatively plentiful. Bilberry, while frequently present, typically occurs only as scattered plants or small patches (*c.f.* Bilberry-holly sub-type). The only other frequent vascular plants are hard fern, scaly male-fern *(Dryopteris affinis)*, wood sorrel and the epiphyte polypody. The principal mosses are *Isothecium myosuroides*, *Kindbergia praelonga*, *Thuidium tamariscinum* and *Hypnum cupressiforme*. Other frequent bryophytes are *Isothecium alopecuroides*, *Lophocolea bidentata*, *Hypnum resupinatum*, *Mnium hornum* and *Polytrichastrum formosum*.

Fig. 1: An example of QL1 woodland, Furbo, Co. Galway. (Photo courtesy of John Cross).

Most appropriate tree species to plant: Sessile oak, birch, Scots pine, holly and rowan.

QL3 Bramble-Hazel *(Rubus fruticosus agg. – Corylus avellana)* sub-type

This type occurs on more fertile and base-rich soil than the above, i.e. on acid brown earths and early stage brown podzolics (pH 4.9), and the flora contains several species characteristic of woodland on calcareous soils. In this respect the stands may be considered as transitional to the ash-ivy woods (see **FH** below). The oak canopy also contains ash *(Fraxinus excelsior)* and sometimes beech. Sycamore, birch and rowan are occasional. The understorey is typically quite dense, being dominated by hazel, with holly often plentiful and with an occasional hawthorn *(Crataegus monogyna)*. In the field layer bramble is abundant and may form extensive, tangled patches. Ivy is also typically abundant while broad buckler-fern, wood sorrel and honeysuckle are very frequent. The presence of several broadleaf herbs distinguishes this vegetation type from the other sessile oak stands. They include bluebell *(Hyacinthoides non-scripta)*, which may be dominant, violet *(Viola riviniana/V. reichenbachiana)*, enchanter's nightshade *(Circaea lutetiana)*, herb-Robert *(Geranium robertianum)*, barren strawberry *(Potentilla sterilis)* and wood avens *(Geum urbanum)*. Woodrush is frequent but typically not plentiful, while bilberry is significantly rare. Amongst the bryophytes the principal species are *Thuidium tamariscinum, Hypnum cupressiforme, Isothecium myosuroides, Kindbergia praelonga* and *Mnium hornum*.

Most appropriate tree species to plant: Sessile oak, birch, ash, hazel, (Scots pine, rowan, holly, hawthorn, wild cherry and crab apple).

FH Ash – Ivy *(Fraxinus excelsior – Hedera helix)* woodland type

Ash, hazel and pedunculate oak woodlands of relatively dry, mostly base-rich, mineral soils in the lowlands (pH typically *c.* 5.9).

Woodlands dominated by ash and hazel are the commonest type in Ireland on dry to moist, fertile soils of the lowlands. They are generally much richer in flowering plants than the sessile oak woods and often have a colourful spring flora with plants such as bluebell, anemone *(Anemone nemorosa)*, primrose *(Primula vulgaris)*, violet, celandine *(Ranunculus ficaria)* and orchids, e.g. early purple orchid *(Orchis mascula)*. Ash is the dominant tree but pedunculate oak is often present as well, although it is sometimes selectively felled. Birch, rowan and elm *(Ulmus glabra)*, as well as the introduced beech and sycamore, may also occur. Hazel is typically the commonest species of the shrub layer, although it is not necessarily dominant, and there are frequently small amounts of hawthorn, holly, spindle *(Euonymus europaeus)* and blackthorn *(Prunus spinosa)*. The introduced cherry laurel locally forms dense thickets. In addition to the species mentioned above the herb layer includes bramble, honeysuckle, ivy, wood avens, wood sorrel, wood speedwell *(Veronica montana)*, barren strawberry, true strawberry *(Fragaria vesca)*, wood-brome *(Brachypodium sylvaticum)*, wild arum *(Arum maculatum)*, wood sanicle *(Sanicula europaea)*, enchanter's nightshade and numerous ferns. Though locally common, mosses and liverworts are generally less abundant and varied than in oak woodlands. These woodlands show a great deal of variation.

FH1 Wood avens – wood speedwell *(Geum urbanum – Veronica montana)* sub-type

This is a fairly broad category that typically occurs on rather moist and fertile mineral soils, i.e. often heavy-textured brown earths and grey-brown podzolic soils (pH 6.1). The canopy is strongly dominated by ash with occasional pedunculate oak and birch. Sycamore is frequent but not plentiful (*c.f.* sycamore-hawthorn sub-type) and beech is only occasional. In the understorey hazel is frequent but not dominant. Hawthorn is also frequent, while holly is occasional. Ivy and bramble are typically major elements of the field layer and may dominate. Characteristic field layer herbs include many of the species listed above as well as broad buckler-fern and shield-fern *(Polystichum setiferum)*. Opposite-leaved saxifrage *(Chrysosplenium oppositifolium)* is occasional on wetter soils. The main moss species are *Thamnobryum alopecurum, Kindbergia praelonga, Brachythecium rutabulum, Thuidium tamariscinum, Eurhynchium striatum, Hypnum cupressiforme, Isothecium myosuroides* and *Neckera complanata*.

Most appropriate tree species to plant: Ash, pedunculate oak, hazel, hawthorn, (birch, holly, spindle, elm, rowan, wild cherry and crab apple).

FH2 Pedunculate oak – bramble *(Quercus robur – Rubus fruticosus)* sub-type

These are oak high forest stands on well-drained mineral soils, which range from base-poor to mildly base-rich in nature, i.e. generally on acid brown earth soils (pH 5.0). They are often associated with old demesnes. Pedunculate oak dominates the canopy with ash a frequent companion. Birch, beech and sycamore are only occasional. The understorey frequently includes hazel, hawthorn and holly. The field layer is variable but is typically rather species-poor as bramble is often dominant and may form extensive tangles. Ivy, honeysuckle and broad buckler-fern are also very frequent. Other ferns that occasionally occur include scaly male-fern, male-fern *(Dryopteris filix-mas)* and lady-fern *(Athyrium filix-femina)*. At some sites bluebell may form large drifts in the spring. On more acidic soils (i.e. acid brown earths and brown podzolics), the field layer may take on the character of stands from the *Quercus petraea – Luzula sylvatica* group with woodrush carpeting the woodland floor. Bracken may occur in areas with a lighter canopy or where the understorey is poorly developed. The main bryophytes are *Kindbergia praelonga, Thuidium tamariscinum, Eurhynchium striatum, Hypnum cupressiforme* and *Isothecium myosuroides*.

Most appropriate tree species to plant: Ash, pedunculate oak, hazel, hawthorn, (birch, holly, wild cherry and crab apple).

Fig. 2: A good example of FH1 woodland, St. John's Wood, Co. Roscommon. (Photo courtesy of BEC Consultants).

FH3 Hazel – wood sorrel *(Corylus avellana – Oxalis acetosella)* sub-type

These are species-rich hazel/ash stands of well-drained, fertile mineral soils (pH 6.1). They include i) stands of species-rich high forest where ash forms a canopy above a sub-canopy of hazel, and ii) hazel scrub/woodland on limestone pavement, shallow, rocky soils and sometimes esker ridges, where the hazel canopy is typically low (5-8 m) and in which ash occurs as scattered emergents. Pedunculate oak, birch, rowan and sycamore are occasional and some of our less common shrubs and trees, e.g. whitebeam *(Sorbus hibernica)*, yew *(Taxus baccata)* and purging buckthorn *(Rhamnus cathartica)* may be present. Bramble, ivy and broad buckler-fern are abundant in the field layer that is typically rich in broadleaf herbs, including wood avens, wood sorrel, bluebell, violets, barren strawberry, herb-Robert, wood sanicle and enchanter's nightshade. The bryophyte layer is often well developed, especially on rocky substrates, with the chief species being *Neckera complanata, Eurhynchium striatum, Thiudium*

tamariscinum, Kindbergia praelonga, Isothecium myosuroides, I. alopecuroides, Rhytidiadelphus triquetrus and *Plagiomnium undulatum*.

Most appropriate tree species to plant: Hazel, ash, hawthorn, (pedunculate oak, birch, holly, yew, purging buckthorn, whitebeam, wild cherry and crab apple).

FH4 Holly – Rowan *(Ilex aquifolium – Sorbus aucuparia)* sub-type

These stands appear to be localised variants occurring in mosaic with other vegetation types, typically on relatively poor, acidic mineral soils (pH 4.5). The canopy is rather variable with birch being the most frequent tree, often accompanied by rowan. Ash is also common while oak (both *Q. robur* and *Q. petraea*) is occasional but locally dominant. Rarely, alder *(Alnus glutinosa)* may form the canopy on wetter ground. The characteristic feature of these stands is the dense understorey of holly with the occasional occurrence of hazel and hawthorn. As a result of the shade the field layer tends to be sparse and species-poor with bramble, ivy, broad leaved buckler-fern, honeysuckle and, to a lesser extent, hard fern being the most frequent and abundant species. The main bryophytes are *Kindbergia praelonga, Thuidium tamariscinum, Eurhynchium striatum, Isothecium myosuroides, Hypnum andoi* and *H. cupressiforme*.

Most appropriate tree species to plant: Birch, holly, rowan, ash, oak (*Q. robur* or *Q. petraea*), (hazel, hawthorn and alder on wetter sites).

FH5 Beech – cherry laurel *(Fagus sylvatica – Prunus laurocerasus)* sub-type*

These highly modified woods are often associated with old demesnes and estates and occur on well-drained, moderately base-rich mineral soils (pH 5.8). They are highly modified variants of other vegetation types, particularly the wood avens-wood speedwell (FH1) and pedunculate oak-bramble (FH2) sub-types. They are species-poor stands with a high component of beech in the canopy or sub-canopy but ash and pedunculate oak may also be very frequent. Sycamore is commonly present. The understorey is rather sparse, being comprised of a few scattered hollies, hawthorns and hazel. Cherry laurel, although used to name the type, is often only occasionally present and rarely abundant. The dense shade and heavy beech litter mean that the field layer is frequently rather scanty. Ivy and bramble are the most abundant species, accompanied by broad buckler-fern and honeysuckle. Bryophytes are insignificant, the principal species being *Kindbergia praelonga, Thuidium tamariscinum, Eurhynchium striatum* and *Isothecium myosuroides*.

Most appropriate tree species to plant: Ash, pedunculate oak, hazel, (hawthorn, holly, wild cherry and birch).

Fig. 3: The very rare TC woodland, Muckross, Killarney, Co. Kerry. (Photo courtesy of John Cross).

FH6 Sycamore – hawthorn *(Acer pseudoplatanus – Crataegus monogyna)* sub-type*

These are stands of well-drained, deep, fertile and base-rich soils in the lowlands (pH 6.2). The canopy is dominated by ash and sycamore with only the occasional presence of beech and pedunculate oak. The understorey is typically well developed and comprises hawthorn, hazel and elder *(Sambucus nigra)*, sometimes with holly and elm. The field layer is rather poorly developed due to the heavy shade and is often dominated by ivy, which can form extensive carpets. Bramble is frequent but tends not to be abundant. A variety of ferns is a common component and includes broad buckler-fern, shield-fern, male-fern and hart's tongue. The principal other species are wood avens, enchanter's nightshade, honeysuckle and violet. Hogweed *(Heracleum sphondylium)* is locally frequent on more fertile sites. Bryophyte diversity is rather poor with *Thamnobryum alopecurum* being the most prominent species.

* See Note 1 on page 4.

Fig. 4: An example of AF2 woodland, Ballyseedy Wood, Co. Kerry. (Photo courtesy of BEC Consultants).

Most appropriate tree species to plant: Ash, hazel, hawthorn, pedunculate oak (wild cherry and holly).

TC Yew-carnation sedge *(Taxus baccata – Carex flacca)* woodland sub-type

This is a very rare and distinctive woodland type occurring in the southwest of the country on shallow, base-rich soils on limestone outcrops or limestone pavement (pH 6.2). It has affinities with the ash-ivy woodlands but is dominated by yew. Ash, although fairly frequent, plays a relatively insignificant role. Hazel is often present but holly is the most common species in the understorey. Rowan, oak (mostly sessile), beech and whitebeam are occasional. The very dense shade cast by the evergreen canopy means that the field layer is very poorly developed. The chief species is the shade-tolerant ivy with occasional bramble, honeysuckle, violet, barren strawberry, carnation sedge, false brome and hart's tongue fern. Much of the biodiversity resides in the bryophyte cover which is often luxuriant and typically comprises *Thamnobryum alopecurum*, *Kindbergia praelonga*, *Isothecium myosuroides*, *Thuidium tamariscinum* and *Eurhynchium striatum*. The peeling bark of the yew trees means there is generally little in the way of epiphytes.

Most appropriate tree species to plant: Yew, ash, (hazel, crab apple and holly).

AF Alder-meadowsweet *(Alnus glutinosa – Filipendula ulmaria)* woodland type

Species-rich wet woodland stands of alder, willow and ash, characteristic of poorly drained gleys, flushes, stream and river margins, lake-shores, and water-logged hollows (pH typically *c.* 6.2).

Typically, these are dominated by alder in the canopy, sometimes with ash and often with grey willow *(Salix cinerea)* in the understorey. The herb layer is very rich in species with an abundance of moisture-loving herbs, e.g. meadowsweet *(Filipendula ulmaria)*, remote sedge *(Carex remota)*, marsh bedstraw *(Galium palustre)*, angelica *(Angelica sylvestris)*, creeping buttercup *(Ranunculus repens)*, water mint *(Mentha aquatica)* and yellow flag *(Iris pseudacorus)*. The most common moss is *Calliergonella cuspidata*. This woodland type is distributed throughout the country but is particularly associated with drumlins and river valleys. There are several sub-types.

AF1 Ash – remote sedge *(Fraxinus excelsior – Carex remota)* sub-type

These stands occur on base-rich, fertile and often mineratrophic gley soils, which may be waterlogged but tend not to be inundated (pH 6.4). Included here are stands of flushed hillsides, stream and river margins, narrow lakeshore woodlands, waterlogged hollows and poorly draining mineral soils elsewhere. Like all vegetation types in this group these stands are species-rich. The canopy is dominated by ash and alder with occasional pedunculate oak and grey willow, although this latter species is typically more abundant in the understorey, along with hawthorn and some holly and hazel. The principal species of the field layer are bramble and meadowsweet, each of which can be abundant. Ivy and honeysuckle are frequent as climbers. The field layer is often diverse and may include remote sedge, lady fern, creeping buttercup, herb-Robert, enchanter's nightshade, wood avens, violet and marsh bedstraw. The principal moss species are *Thuidium tamariscinum, Thamnnobryum alopecurum, Eurhynchium striatum, Kindbergia praelonga, Plagiomnium undulatum* and *Isothecium myosuroides*.

Most appropriate tree species to plant: Ash, alder, grey willow, hawthorn, (pedunculate oak, holly and hazel).

Fig. 5: An AF3 woodland at Hazelwood demesne, Co. Sligo. (Photo courtesy of John Cross).

AF2 Alder – bramble *(Alnus glutinosa – Rubus fruticosus)* sub-type

These are alder-grey willow stands of base-rich, fertile mineratrophic and organic-rich gleys or fen peats which are waterlogged or periodically inundated (pH 5.9). Included in this category are alder carr associated with lakes and stands of wet hollows and river flood plains. The canopy is dominated by alder with grey willow a frequent associate, but this latter species is not dominant (*c.f.* grey willow-water horsetail sub-type). Ash is also commonly present but is not a major component. Hawthorn is the main understorey species. The field layer is dominated by bramble while ivy, creeping bent *(Agrostis stolonifera)*, creeping buttercup, broad buckler-fern, meadowsweet, remote sedge, opposite-leaved saxifrage, angelica, soft rush *(Juncus effusus)*, lady-fern and herb-Robert are frequent components. Less frequent but characteristic species include yellow flag, floating sweet-grass *(Glyceria fluitans)*, water mint and Yorkshire fog *(Holcus lanatus)*. The bryophytes consist mainly of *Kindbergia praelonga, Isothecium myosuroides, Calliergonella cuspidata, Thuidium tamariscinum* and *Hypnum cupressiforme*.

Most appropriate tree species to plant: Alder, grey willow, hawthorn (and ash).

AF3 Grey willow-water horsetail *(Salix cinerea – Equisetum fluviatile)* sub-type

This vegetation type comprises willow-dominated wet woodland stands of waterlogged, regularly inundated or permanently submerged ground. Soils are typically base-rich, organic and highly fertile and include lakeside willow carr on fen peats, stands on degraded bog margins and on organic-rich gley soils elsewhere (pH 6.3). These stands are strongly dominated by grey willow which typically occurs as sprawling, collapsed trees, with horizontal, often partially submerged trunks sending up numerous vertical stems into the low canopy. Ash and alder are frequent but typically provide little cover. The field layer is characteristically dominated by bramble, ivy and meadowsweet. Other frequent field layer species are remote sedge, broad buckler-fern, creeping bent, water mint, canary reed-grass *(Phalaris arundinacea)*, marsh bedstraw, angelica, water horsetail and cuckoo flower *(Cardamine pratensis)*. Bryophyte cover is typically low with the most frequent species being *Calliergonella cuspidata, Kindbergia praelonga, Isothecium myosuroides* and *Brachythecium rutabulum*.

Most appropriate tree species to plant: These habitats are **unsuitable** for planting.

AF4 Hawthorn-herb-Robert *(Crataegus monogyna – Geranium robertianum)* sub-type

This is a diverse vegetation type, occurring on a variety of soils, in which hawthorn is a strong component (pH 6.6). On wet, mineratrophic gleys stands of alder are found with a dense understorey of hawthorn and a field layer of meadowsweet, creeping bent, opposite-leaved saxifrage, soft rush and creeping buttercup. A second variant occurs on relatively well-drained, base-rich mineral soils. These consist of scrubby stands in which ash is an abundant component. Hawthorn essentially replaces hazel as the main understorey component, or forms a low canopy where blackthorn may also be frequent. The field layer may contain bramble, ivy, broad buckler-fern, wild arum, herb-Robert, violet, wood avens, enchanter's nightshade and primrose *(Primula vulgaris)*. A third but very rare variant consists of low scrub woodland found on the upper margins of turloughs and dominated by hawthorn and purging buckthorn. The main bryophytes associated with this vegetation type are *Thamnobryum alopecurum*, *Eurhynchium striatum*, *Kindbergia praelonga*, *Thuidium tamariscinum* and *Isothecium alopecuroides*, with *Pellia epiphylla* on wetter soils.

The relative scarcity of hazel in the drier variant helps differentiate those stands from closely related stands in the ash-ivy woodland type.

Most appropriate tree species to plant: Alder, ash and hawthorn. Land around the margins of turloughs should **not** be planted.

AF5 Birch – water mint *(Betula pubescens – Mentha aquatica)* sub-type

Mixed broadleaf stands on mineral to organic-rich, base-rich soils which are waterlogged or periodically inundated (pH 6.4). They occur along lakeshores, on fen peats and in waterlogged hollows. The canopy is a combination of alder, grey willow, ash and birch. The abundance of birch serves to distinguish these stands from others in this group, while the abundance of alder and ash differentiate this vegetation type from the grey willow-marsh bedstraw vegetation type of the birch-purple moor-grass woodland type (BM6). Hawthorn and guelder rose *(Viburnum opulus)* are frequent in the understorey but provide sparse cover. In the field layer meadowsweet and canary reed-grass are usually dominant, often covering large areas. Other frequent field layer species include water mint, yellow flag, valerian *(Valeriana officinalis)*, purple loosestrife *(Lythrum salicaria)*, yellow loosestrife *(Lysimachia vulgaris)*, marsh bedstraw, angelica, tufted hair-grass *(Deschampsia cespitosa)*, remote sedge, creeping bent and marsh marigold *(Caltha palustris)*. Bryophyte cover is rather scanty with the only frequent species being *Climacium dendroides*, *Kindbergia praelonga* and *Hypnum cupressiforme*.

Most appropriate tree species to plant: Alder, grey willow, ash, birch, (hawthorn and guelder rose).

Fig. 6: An example of BM1 woodland from Ballyoughter, Co. Tipperary. (Photo courtesy of BEC Consultants).

AF6 Alder – tussock sedge *(Alnus glutinosa-Carex paniculata)* sub-type

A rare, wetland community dominated by grey willow and alder on calcareous, peaty substrates. Tussock sedge dominates the field layer producing treacherous terrain of large tussocks separated by open water or liquid peat. The tussocks provide a substrate for colonisation by other species, e.g. water mint, wood avens and hard fern.

Most appropriate tree species to plant: These woodlands are **unsuitable** for planting.

AF7 Alder – giant horsetail *(Alnus glutinosa – Equisetum telmateia)* sub-type

A rare wetland community found on slopes flushed with calcareous groundwater. The rather open stands of alder and ash are characterised by beds of giant horsetail, which grow to over 1 m tall. Swards of the moss *Cratoneuron commutatum* occur, washed by trickles and runnels of water which leave deposits of calcium carbonate forming a white crust or tufa.

Most appropriate tree species to plant: These sites are **unsuitable** for planting.

SU Almond willow-nettle *(Salix triandra – Urtica dioica)* woodland sub-type

This woodland type occurs predominantly on gley soils on islands and banks of lowland rivers which are frequently inundated. It is particularly common in the lower reaches of rivers which are subject to tidal, although not saline, influence. The soils are mostly mineratrophic gleys, base-rich and highly fertile due to alluvial deposition (pH 7.2). The canopy is dominated by a mixture of non-native willow species: almond willow, osier *(S. viminalis)*, white willow *(S. alba)* and crack-willow *(S. fragilis)*. While these stands are wet woodland, they differ significantly from those of the alder-meadowsweet group as a result of the rarity or absence of both alder

and grey willow. Sycamore, horse-chestnut *(Aesculus hippocastanum)* and beech are occasional in the canopy, underlining the strong non-native element to these stands. The field layer is characteristically a dense tangle of species which, together with fallen and uprooted trees and branches, makes access extremely difficult. Common species include nettle, hedge bindweed *(Calystegia sepium)*, canary reed-grass, water dropwort *(Oenanthe crocata)*, angelica, meadow-sweet, ivy, woody nightshade *(Solanum dulcamara)*, valerian, yellow flag and goose-grass. Beneath this undergrowth smaller species, such as water mint, wood dock *(Rumex sanguineus)*, remote sedge, creeping buttercup, hart's tongue and cuckoo flower, are frequent. Bryophyte cover is sparse, the chief species being *Kindbergia praelonga*, *Rhizomnium punctatum* and *Brachythecium rutabulum*.

Although the tree element of this type is largely non-native, the very open character of the canopy allows the strong growth of native herbs. The stands play an important role in the dynamics of riverine systems and have important hydrological and ecological functions.

Most appropriate tree species to plant: Despite the absence of native species in existing stands it would be appropriate to plant grey willow and alder as well as the other willow species listed above.

BM Birch – purple moor-grass *(Betula pubescens – Molinia caerulea)* woodland type

Woodlands of degraded or intact raised bogs and peaty hollows and locally on mineral soils (pH typically *c.* 4.6).

These woodlands are dominated by birch, often with very few other tree or shrub species, although locally, Scots pine may be abundant. They are typically species-poor with the principal species being purple moor-grass, bramble and broad buckler-fern and sometimes mono-dominant stands of bracken. Mosses and liverworts may be abundant, e.g. *Pseudoscleropodium purum, Thuidium tamariscinum, Kindbergia praelonga, Hypnum jutlandicum, Lophocolea bidentata,* including epiphytic bryophytes, e.g. *Ulota bruchii/U. crispa*. Birch woodlands are principally associated with cutaway (locally intact) raised bogs but also occur in association with sessile oak or ash woodlands, either as inclusions on wet peats or as an early successional stage.

BM1 Bramble-broad buckler-fern *(Rubus fruticosus – Dryopteris dilatata)* woodland sub-type

These are markedly species-poor stands occurring predominantly on dry, degraded basin peats (pH 4.3). Grey willow may be frequent in the canopy with occasional rowan while holly forms a rather sparse understorey and Scots pine may be present locally. Bramble is typically dominant in the field layer and may form dense tangles covering extensive areas. Bracken is prevalent where the canopy is thinner but the most abundant fern species is broad buckler-fern. Raspberry *(Rubus idaeus)* occurs occasionally. Other vascular plants in the field layer, which is sparse, frequently include ivy, purple moor-grass, honeysuckle and hard fern. The moss layer is dominated by *Thuidium tamariscinum* and *Kindbergia praelonga* with *Polytrichastrum formosum*, *Pseudoscleropodium purum*, and *Lophocolea bidentata* all occurring frequently.

Most appropriate tree species to plant: Birch, grey willow, Scots pine, (rowan, holly and silver birch *(Betula pendula)*).

BM2 Bilberry-woodrush *(Vaccinium myrtillus – Luzula sylvatica)* sub-type

These are birch-dominated stands on acidic soils with a high organic content (pH 4.3), which contain several elements of sessile oak forest (*c.f.* Sessile oak – woodrush type). They occur in two main situations: on dry, degraded basin peats in the lowlands and on well-advanced acidic podzols in the uplands. In the latter situation these stands may be viewed as a seral stage in succession towards high oak *(Q. petraea)* forest. The main canopy species is birch but sessile oak, rowan and holly are frequent associates although they are not abundant. Scots pine and grey willow occur occasionally. The dwarf shrub layer is characterised by an abundance of bilberry and the field layer by woodrush with bramble and broad buckler-fern. Wood sorrel, hard fern and honeysuckle are also fairly frequent. The moss layer may be well developed and is dominated by *Thuidium tamariscinum*, with other species frequently occurring, including *Kindbergia praelonga*, *Hypnum cupressiforme, Dicranum scoparium, Isothecium myosuriodes, Rhytidiadelphus triquetrus, Lophocolea bidentata, Polytrichastrum formosum* and *Pseudoscleropodium purum*.

Most appropriate tree species to plant: Birch, sessile oak, Scots pine, rowan, holly (and grey willow).

BM3 Yorkshire fog – bent grass *(Holcus lanatus – Agrostis capillaris)* sub-type

This is a rather variable group in which the key field layer species of the other sub-types are absent. Although predominantly associated with degraded basin peats, they are found on a range of soils (pH 4.9). Typically however, these are birch stands of moist, acidic soils with a grassy element to the field layer due to heavy grazing. The canopy is strongly dominated by birch, with grey willow frequent and an occasional rowan and Scots pine. Holly is frequent in the understorey, sometimes with hazel. Ivy is notably scarce compared with other birch stands on mineral soils (*c.f.* ivy-ash sub-type) but bramble and broad buckler-fern are very frequent, although typically not dominant. The grassy aspect to the field layer consists of combinations of Yorkshire fog, purple moor-grass, bent grasses (*Agrostis capillaris*, *A. stolonifera*, *A. canina* and *A. vinealis*) and sweet vernal-grass *(Anthoxanthum odoratum)*. Soft rush and honeysuckle are frequent components, while bracken, bilberry, creeping buttercup and tormentil are occasional. The chief bryophyte species are *Thuidium tamariscinum, Kindbergia praelonga, Polytrichastrum formosum, Lophocolea bidentata, Dicranum scoparium, Isothecium myosuroides, Pseudoscleropodium purum* and *Polytrichum commune*.

Most appropriate tree species to plant: Birch, grey willow, holly, Scots pine, (rowan and hazel).

BM4 Ivy – ash *(Hedera helix – Fraxinus excelsior)* sub-type

These birch stands frequently occur on relatively well-drained mineral soils in addition to degraded basin peats (pH 4.7). Although the canopy is dominated by birch they are characterised by an abundance of ash and other elements of ash-ivy woodlands and in many cases are almost certainly successional stages developing towards this woodland type. Grey willow occurs regularly but provides little cover while oaks (*Q. robur* and *Q. petraea*) are occasional. Beech and sycamore are more common than in other birch woodlands but are not frequent. Hawthorn, hazel, holly and rowan are all frequent in the understorey. The field layer comprises species characteristic of mineral soils and more shaded conditions compared with those found in other birch woodlands types. Ivy in particular, may be very abundant, carpeting large areas of the woodland floor, and bluebell may form large patches. Bramble and broad buckler-fern are abundant and violet, herb-Robert, wood avens, enchanter's nightshade, male-fern, scaly male-fern and shield-fern may all be present. The principal bryophytes are *Kindbergia praelonga, Thuidium tamariscinum, Eurhynchium striatum, Isothecium myosuroides* and *Thamobryum alopecurum*.

Most appropriate tree species to plant: Birch, ash, hawthorn, grey willow, rowan, holly, (pedunculate oak, sessile oak and silver birch).

BM5 Grey willow – marsh bedstraw *(Salix cinerea – Galium palustre)* sub-type

These species-rich woodland stands occur on a range of peaty sites from damp, degraded raised bogs to floating fen peats (pH 5.2). The stands all differ from the wet woodlands of the alder-meadowsweet type in that the canopy is dominated by a mixture of birch and grey willow with ash being frequent but providing only sparse cover and alder being significantly rare. Holly and hawthorn are frequent in the understorey. Bramble may be a strong component in the field layer but is less abundant than in the drier bramble-broad buckler-fern sub-type, although, along with ivy, is a constant species. The field layer is, however, characterised by a suite of herbs typical of wet ground which may include water mint, meadowsweet, water horsetail, marsh cinquefoil *(Potentilla palustris)*, floating sweet-grass, bent grasses, soft rush, Yorkshire fog and tufted hair-grass. Marsh bedstraw is a particularly good indicator of this sub-type. The ground layer is dominated by *Calliergonella cuspidata*, *Thuidium tamariscinum* and *Kindbergia praelonga*. *Hypnum cupressiforme* often forms large patches on fallen trees. *Ulota* species are frequent as epiphytes.

Most appropriate tree species to plant: Birch, grey willow, hawthorn, holly, (ash and silver birch). Very wet variants of this sub-type are **unsuitable** for planting.

BM6 Purple moor-grass – tormentil *(Molinia caerulea – Potentilla erecta)* sub-type

These are stands of birch woodland typically occurring on basin peats where the water table is high (pH 5.2). Included within this category are rare native woodland communities associated with soak systems* on raised bogs, stands in peaty hollows in the uplands and woodlands occurring on partially degraded bogs. The light, sometimes very open canopy is dominated by birch, with grey willow also frequent and locally Scots pine. Alder is rare while *Salix x multinervis* is occasional in the shrub layer. The other most important features are the striking dominance of purple moor-grass in the field layer and the abundance of

* *Soak systems are localised areas of nutrient enrichment associated with concentrated surface flow across the surface of a raised bog.*

Sphagnum spp. in the ground layer. Chief among these is *Sphagnum palustre* with other species including *S. recurvum agg.*, *S. capillifolium*, *S. subnitens*, *S. fimbriatum* and *S. cuspidatum* along with *Aulacomnium palustre* and *Pleurozium schreberi*. Tormentil and soft rush are frequent amongst the *Molinia* tussocks and bramble and broad buckler-fern are constant but seldom abundant and provide little in the way of cover. Other indicative species includes bog myrtle *(Myrica gale)*, valerian and cross-leaved heath *(Erica tetralix)*.

Most appropriate tree species to plant: These sites are **unsuitable** for planting.

Low woodland/scrub (vegetation dominated by woody plants less than 5 m in height, or 4 m in the case of wetland woods)

LW Low woodland

NB. There is a variety of scrub types, mostly formed by hazel, hawthorn, blackthorn, birch and willow but sometimes also by other species. They vary considerably in character depending on nearby seed sources and former management. In most cases they represent early stages in succession to one or other of the high forest communities described above.

LW1 Blackthorn *(Prunus spinosa)* scrub

Thickets of blackthorn, which, on account of their dense and thorny nature, are virtually impenetrable. Ash is often emergent and bramble may also be present, but the field and moss layers are very poorly developed due to the dense shade. This is a seral stage to ash-ivy woodlands and stands occur frequently on abandoned pasture on base-rich soils (pH typically > 6.5).

Most appropriate tree species to plant: Ash, pedunculate oak, hazel, hawthorn, (birch, holly, spindle, elm, wild cherry, crab apple and rowan).

LW2 Hazel *(Corylus avellana)* scrub

Species-poor stands of hazel less than 5 m tall on fertile, calcareous soils of varying depth which, like blackthorn scrub, have developed as a result of land abandonment (pH typically > 6.0). Typically, they are dominated by dense hazel, with hawthorn, and have a poorly developed and species-poor field layer with elements of the grasses and herbs which occurred in the open land prior to scrub invasion. Ivy, bramble, wild rose *(Rosa spp.)* and bracken may also be present. These stands are not to be confused with the FH3 Hazel – wood sorrel *(Corylus avellana – Oxalis acetosella)* sub-type which is usually much richer in species and has a better developed structure.

Most appropriate tree species to plant: Ash, pedunculate oak, hawthorn, (birch, holly, spindle, elm, wild cherry, crab apple and rowan).

LW3 Juniper *(Juniperus communis)* scrub

Juniper stands or formations occur in two widely different habitats: on (a) dry acidic soils characterised by heath vegetation with ling heather, bell heather *(Erica cinerea)*, grasses and herbs, and on (b) shallow limestone soils, often over limestone pavement, with a variety of grasses and herbs typical of such soils, i.e. rendzinas and shallow brown earths.

Most appropriate tree species to plant: This is a rare vegetation type which occurs on land that is **unsuitable** for planting.

CONCLUSIONS

The introduction of a new woodland classification system is necessary as the National Survey of Native Woodland identified a greater variety of woodland types than had been previously described. In particular, it includes information from parts of the country which had previously been unsurveyed or only poorly surveyed. Though this means that practitioners must acquaint themselves fully with the new system, there is no doubt that this more comprehensive classification will facilitate native woodland management planning and, in particular, the application of the NWS. It is especially relevant to the development of new native woodlands on greenfield sites where there are few clues in the immediate vicinity as to what would be the most appropriate woodland type to establish, i.e. no hedgerows or adjacent semi-natural woodland. However, it should be recognised that minor and/or rare woodland types may still remain which have not been described and that inevitably some sites will be transitional and will not fit comfortably into any category. Nevertheless, the new system set out in this Information Note should account for the majority of native woodland types extant in Ireland, thereby assisting practitioners more fully in the application of the NWS and other native woodland projects.

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REFERENCES

Cross, J.R. 2008. *Native Woodland Scheme Classification System.* In: Native Woodland Scheme Manual (Appendix 7). Forest Service, Department of Agriculture, Fisheries & Food, Johnstown Castle Estate. Wexford.

Dobson, F.S. 2000. *Lichens: an illustrated guide to the British and Irish species.* 4th edition. Richmond Publishing, Slough.

Forest Service. 2008. Native Woodland Scheme Manual. Forest Service, Department of Agriculture, Fisheries & Food, Johnstown Castle Estate. Wexford.

Fossitt, J.A. 2000. A Guide to Habitats in Ireland. The Heritage Council, Kilkenny.

Horgan, T., Keane, M., McCarthy, R., Lally, M. and Thompson, D. 2003. *A Guide to Forest Tree Species Selection and Silviculture in Ireland.* Ed. O'Carroll, J. COFORD, Dublin.

Joyce, P. M., Huss, J., McCarthy, R., Pfeifer, A. and Hendrick. E. 1998. *Growing Broadleaves. Silvicultural Guidelines for Ash, Sycamore, Wild Cherry, Beech and Oak in Ireland.* COFORD, Dublin.

Little, D., Collins, K., Cross, J., Cooke, D. and McGinnity, P. 2008. *Native Riparian Woodlands – A Guide to Identification, Design, Establishment and Management.* Native Woodland Scheme Information Note No. 4. Woodlands of Ireland. Dublin.

Little, D., Curran, E., Horgan, T., Cross, J., Doyle, M. and Hawe, J. 2009. *Establishment, Design and Stocking Densities of New Native Woodlands.* Native Woodland Scheme Information Note No. 5. Woodlands of Ireland. Dublin.

Little, D.J. and Cross, J.R. 2005. *Realising Quality Wood from Ireland's Native Woodlands. Silvicultural Guidelines for Wood Production in the Context of the Native Woodland Scheme.* Woodlands of Ireland. Dublin.

Paton, J.A. 1999. *The liverwort flora of the British Isles.* Harley Books, Colchester.

Perrin, P., Martin, M., Barron, S., O'Neill, F., McNutt, K. and Delaney, A. 2008. *National Survey of Native Woodlands 2003-2008.* Unpublished report to the National Parks & Wildlife Service. Dublin. *www.npws.ie*

Rodwell, J. 1991. *British Plant Communities. 1: Woodland and Scrub.* University Press. Cambridge.

Smith, A.J.E. 2004. *The moss flora of Britain and Ireland.* 2nd edition. Cambridge University Press, Cambridge.

Stace, C. 1997. *New flora of the British Isles.* 2nd edition. Cambridge University Press, Cambridge.

FURTHER READING

Barron, C. 2007. *The Control of Rhododendron in Native Woodlands.* Native Woodland Scheme Information Note No. 3. Woodlands of Ireland. Dublin.

Byrnes, E. 2007a. *Cartographic and Historical Sources for Native Woodlands.* Native Woodland Scheme Information Note No. 1. Woodlands of Ireland. Dublin.

Byrnes, E. 2007b. *A History of Woodland Management in Ireland: An Overview.* Native Woodland Scheme Information Note No. 2. Woodlands of Ireland. Dublin.

Cross, J.R. 2005. *The Potential Natural Vegetation of Ireland.* Proceedings of the Royal Irish Academy, 106B, 65-116.

Cross, J.R. and Kelly, D. L. 2003. *Wetland woods.* In R. Otte (Ed.) Wetlands of Ireland. pp160-172.

Forest Service. 2000. *Code of Best Forest Practice – Ireland.* Forest Service, Department of Agriculture, Fisheries & Food, Johnstown Castle Estate. Wexford.

Forest Service. 2003. Forestry Schemes Manual. Forest Service, Department of Agriculture, Fisheries & Food, Johnstown Castle Estate. Wexford.

Gardiner, M.J. and Radford, T. 1980. *Soil Associations of Ireland and their Land Use Potential.* National Soil Survey of Ireland A.F.T. Soil Survey Bull. No. 36. An Foras Taluntais. Dublin.

Peterken, G.F. 2002. *Reversing the Habitat Fragmentation of British Woodlands.* WWF-UK. Godalming.

Pryor, S.N., Curtis, T.A. and Peterkin, G.F. 2002. *Restoring Plantations on Ancient Woodland Sites.* The Woodland Trust. England. *(www.woodland-trust.org.uk/policy/publications.htm)*

Rodwell, J.S. and Patterson, G.S. 1994. *Creating New Native Woodlands.* Forestry Commission Bulletin 112. HMSO. London.

Thompson, R.N., Humphrey, J.W., Harmer, R. and Ferris, R. 2003. *Restoration of Native Woodland on Ancient Woodland Sites.* Forestry Commission Practice Guide. Forestry Commission. Edinburgh. ISBN 0 85538 579 0

APPENDIX 1

Relationship between the revised woodland classification presented in this Information Note and other woodland classification systems. Note: The table below gives the closest affinities between the different classification systems. In some cases the fit is close, in others tenuous or uncertain. Further details can be found in Perrin *et al*. (2008). Sub-types coloured pink are relatively rare in Ireland, sometimes in a complex or mosaic with other sub-types.

New NWS types	New NWS sub-types	Old NWS types	Fossitt types (Fossitt, 2000)	Habitats Directive Annex 1 listed habitats	Phytosociological categories
Quercus-Luzula (QL)					
	Vaccinium – Ilex (QL1)	A1, A2	WN1	Old oak woods	*Blechno-Quercetum scapanietosum/typicum*
	Luzula – Dryopteris (QL2)	A1, A2	WN1	Old oak woods	*Blechno-Quercetum scapanietosum/typicum*
	Rubus – Corylus (QL3)	A3	WN1, WN2, WD2	Old oak woods	*Blechno-Quercetum coryletosum*
Fraxinus-Hedera (FH)					
	Geum – Veronica (FH1)	B1	WN2, WD1	Alluvial forests	*Corylo-Fraxinetum veronicetosum*
	Quercus – Rubus (FH2)	B1, A3	WN1, WN2	No equivalent	*Corylo-Fraxinetum typicum*
	Corylus – Oxalis (FH3)	B2, G2	WN2	Limestone pavement – scrubby facies	*Corylo-Fraxinetum veronicetosum/ neckeretosum*
	Ilex – Sorbus (FH4)	A1, B1	WN1, WN2	No equivalent	*Blechno-Quercetum typicum/coryletosum*
	Fagus – Prunus (FH5)	B1	WD1, WN2	No equivalent	Not described
	Acer – Crataegus (FH6)	B1	WD1, WN2	No equivalent	*Corylo-Fraxinetum typicum*
	Taxus – Carex (TC)	B3	WN3	Yew woods	*Corylo-Fraxinetum neckeretosum*
Alnus – Filipendula (AF)					
	Fraxinus – Carex remota (AF1)	E3, C1	WN6, WN4	Alluvial forests	*Carici remotae-Fraxinetum/ Corylo-Fraxinetum deschampsietosum*
	Alnus – Rubus (AF2)	C2, C1	WN6	Alluvial forests	*Osmundo-Salicetum/Alnus glutinosa – Carex paniculata coenon*
	Salix – Equisetum (AF3)	E1, C2	WN6	Alluvial forests	*Osmundo-Salicetum*
	Crataegus – Geranium (AF4)	C2	WN2, WN6	Alluvial forests/ Turloughs	*Corylo-Fraxinetum veronicetosum*

New NWS types	New NWS sub-types	Old NWS types	Fossitt types (Fossitt, 2000)	Habitats Directive Annex 1 listed habitats	Phytosociological categories
	Betula – Mentha (AF5)	C2	WN6	Alluvial forests	*Osmundo-Salicetum*
	Alnus – Carex paniculata (AF6)	E2	WN6	Alluvial forests	*Alnus glutinosa – Carex paniculata coenon*
	Alnus – Equisetum (AF7)	None	FP1	Petrifying springs	*Equiseto telmatejae-Fraxinetum association*
	Salix – Urtica (SU)	D	WN5, WD1	Alluvial forests	*Salicetum albae*
Betula – Molinia (BM)					
	Rubus – Dryopteris (BM1)	F1	WN7	No equivalent	*Vaccinio uliginosi – Betuletum*
	Vaccinium – Luzula (BM2)	F1, WN1	WN1, WN7	Old oak woods	*Vaccinio uliginosi – Betuletum/Blechno-Quercetum*
	Holcus – Agrostis (BM3)	F1, WN1	WN7, WN1	No equivalent	Not described
	Hedera – Fraxinus (BM4)	F1, WN1	WN7, WN2	No equivalent	*Corylo-Fraxinetum*
	Salix – Galium (BM5)	None	WN7, WN6	Alluvial forests	*Osmundo-Salicetum/ Sphagnum palustre – Betula pubescens coenon*
	Molinia – Potentilla (BM6)	F2	WN7	Bog woodland	*Sphagnum palustre – Betula pubescens coenon/ Salicetum auritae*
Low woodland (LW)					
	Prunus spinosa (LW1)	L	WS1	No equivalent	*Corylo-Fraxinetum*
	Corylus avellana (LW2)	G	WS1	No equivalent	*Corylo-Fraxinetum*
	Juniperus (LW3)	K	WS1	Juniper formations	Various

APPENDIX 2

A list of the appropriate tree and shrub species to plant in each woodland sub-type. Sub-types coloured pink are relatively rare in Ireland, sometimes in a complex or mosaic with other sub-types. Brackets indicate minor components of the woodland which should only be planted in small quantities. Sub-types that are unsuitable for planting are **not** included in this Appendix.

	Sessile oak	Birch	Rowan	Holly	Scots Pine	Ash	Hazel	Hawthorn	Pedunculate oak	Wild cherry	Crab apple	Alder	Grey willow	Spindle	Elm	Yew	White-beam	Purging buck-thorn	Guelder rose	Silver birch	Salix species
QL Sessile oak – woodrush *(Quercus petraea – Luzula sylvatica)* woodland type																					
QL1 Bilberry-holly *(Vaccinium myrtillus – Ilex aquifolium)* sub-type	x	x	x	x	x																
QL2 Woodrush – broad buckler fern *(Luzula sylvatica – Dryopteris dilatata)* sub-type	x	x	x	x	x																
QL3 Bramble-Hazel *(Rubus fruticosus agg. – Corylus avellana)* sub-type	x	x	(x)	(x)	(x)	x	x	(x)		(x)	(x)										
FH Ash – Ivy *(Fraxinus excelsior – Hedera helix)* woodland type																					
FH1 Wood avens – wood speedwell *(Geum urbanum – Veronica Montana)* sub-type		(x)	(x)	(x)		x	x	x	x	(x)	(x)			(x)	(x)						
FH2 Pedunculate oak – bramble *(Quercus robur – Rubus fruticosus)* sub-type		(x)		(x)		x	x	x	x	(x)	(x)										
FH3 Hazel – wood sorrel *(Corylus avellana – Oxalis acetosella)* sub-type		(x)		(x)		x	x	x	(x)	(x)	(x)					(x)	(x)	(x)			
FH4 Holly – Rowan *(Ilex aquifolium – Sorbus aucuparia)* sub-type	x	x	x	x		x	(x)	(x)	x			(x)									
FH5 Beech – cherry laurel *(Fagus sylvatica – Prunus laurocerasus)* sub-type (see Note 1, page 4)		(x)		(x)		x	x	(x)	x	(x)											
FH6 Sycamore – hawthorn *(Acer pseudoplatanus – Crataegus monogyna)* sub-type (see Note 1, page 4)				(x)		x	x	x	x	(x)											
TC Yew-carnation sedge *(Taxus baccata – Carex flacca)* sub-type				(x)		x	(x)				(x)					x					

	Sessile oak	Birch	Rowan	Holly	Scots Pine	Ash	Hazel	Hawthorn	Pedunculate oak	Wild cherry	Crab apple	Alder	Grey willow	Spindle	Elm	Yew	White-beam	Purging buck-thorn	Guelder rose	Silver birch	Salix species
AF Alder-meadowsweet *(Alnus glutinosa – Filipendula ulmaria)* woodland type																					
AF1 Ash – remote sedge *(Fraxinus excelsior – Carex remota)* sub-type				(x)		x	(x)	x	(x)			x	x								
AF2 Alder – bramble *(Alnus glutinosa – Rubus fruticosus)* sub-type						(x)		x				x	x								
AF4 Hawthorn-herb-Robert *(Crataegus monogyna – Geranium robertianum)* sub-type						x		x				x									
AF5 Birch – water mint *(Betula pubescens – Mentha aquatica)* sub-type		x				x		(x)				x	x						(x)		
SU Almond willow-nettle *(Salix triandra – Urtica dioica)* sub-type												x	x								x
BM Birch – purple moor-grass *(Betula pubescens – Molinia caerulea)* woodland type																					
BM1 Bramble-broad buckler-fern *(Rubus fruticosus – Dryopteris dilatata)* sub-type		x	(x)	(x)	x								x							(x)	
BM2 Bilberry-woodrush *(Vaccinium myrtillus – Luzula sylvatica)* sub-type	x	x	x	x	x								(x)								
BM3 Yorkshire fog-bent grass *(Holcus lanatus – Agrostis capillaris)* sub-type		x	(x)	x	x		(x)						x								
BM4 Ivy – ash *(Hedera helix – Fraxinus excelsior)* sub-type	(x)	x	x	x		x		x	(x)				x							(x)	
BM5 Grey willow – marsh bedstraw *(Salix cinerea – Galium palustre)* sub-type		x		x		(x)		x					x							(x)	
LW1 Blackthorn *(Prunus spinosa)* scrub		(x)	(x)	(x)		x	x	x	x	(x)	(x)			(x)	(x)						
LW2 Hazel *(Corylus avellana)* scrub		(x)	(x)	(x)		x		x	x	(x)	(x)			(x)	(x)						