Fingal Hedgerow Survey Report

Staidéar Fálta Sceach Chontae Fhine Gall

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TCD School of Botany

Dog Rose blossoming in a remnant hedge, St. Margaret's Parish, Fingal

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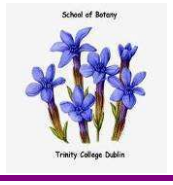
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Cover photo of the hedgerow landscape in the townland of Curragh East by the author. The rear photo "Parted Way" is courtesy of Matt Holler, and the photograph of the

ancient ash coppice at St. Margaret's parish on page 56 is by Dr. D.L. Kelly. All other photographs are by the author.

INTRODUCTION

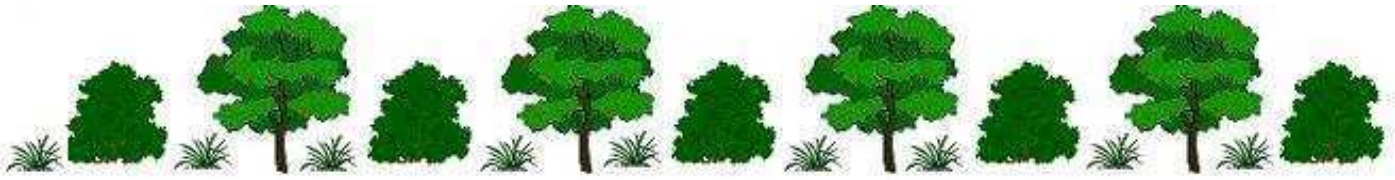
1.0 Background

Hedgerows are an integral part of Irish landscape history, and the estimated 382,000 km of hedgerows (Smal 1995) that span the countryside give the Republic of Ireland, as one of the least wooded nations of Europe, the illusion of being relatively well-wooded. In spite of the fact that hedgerows are a vital part of the Irish landscape, benefiting people and wildlife alike, very little is known in terms of their history and ecology; and only in the recent years of expanded awareness of our threatened natural heritage has interest increased in the role that hedgerows play in the landscape.

With a population of 240,000 and a growth rate of approximately 20,000 people per year, Fingal is one of the most densely populated and fastest growing regions of Ireland (www.fingal.ie, *Fingal Development Board 2006*). Unless proper planning is implemented under the Fingal Development Plan 2005-2011, this will have disastrous consequences for the region's unique natural and agricultural heritage as development projects destroy wood, hedgerow and field alike. As a result, in 2003, a biodiversity assessment of north Dublin County was initiated by Fingal County Council's Parks Division as a part of Fingal's Local Biodiversity Action Plan Programme. In accordance with guidelines first established under the National Biodiversity Plan and the EU Habitats Directive, the programme attempts to catalogue the biodiversity of Fingal's natural and semi-natural areas and identify priority areas for conservation purposes. The Fingal Development Plan 2005-2011 also provides for hedgerow conservation with policy number HP45 which states that the planning commission of the local authority must undertake to

"… protect existing woodlands, trees and hedgerows which are of amenity or biodiversity value and/or contribute to landscape character, and to ensure that proper provision is made for their protection and management, when undertaking, approving or authorising development."
(www.fingalcoco.ie, *Fingal County Council Development Board 2006*)

In the spring of 2006, as part of the local biodiversity assessment, a vegetation survey of hedgerows in the Fingal region was commissioned by the county council. The focus of the study was to be on the species composition, structure, extent and current management of hedgerows in the county, with suggestions to be made for the future management and conservation of this resource.



Hedgerows of Fingal, near Garristown

1.1 What is a hedgerow?

Merriam-Webster gives the definition of a hedgerow as "a row of trees or shrubs separating or enclosing fields" (http://www.m-w.com, October 2006) but a hedgerow can be defined as a planted or naturally arising linear strip of shrubs/trees which forms a field-boundary and is, or was once, managed in such a way as to provide a stock-proof barrier (Barnes & Williamson 2006). Hedgerows come in a wide variety of shapes, sizes, forms and composition; from tall, semi-natural hedges carved from woodland and comprised mainly of native species of local provenance, to short, square-clipped hedges enclosing fields and gardens. They may be comprised of one single species, such as the evergreen exotic cypress hedges (*Chamaecyparis, Cupressus* spp.) that are widely planted as screens around gardens, the fuchsia hedges of the western seaboard, and the newly planted whitethorn hedges (*Crataegus monogyna*) of roadsides and field margins; or they may be comprised of many species, either through deliberate planting or natural recruitment over time.

1.2 Value of Hedges

The significance of hedgerows to wildlife, agriculture, tourism, history, the local economy, local communities and the wider landscape in general has been the subject of intensive study in Britain (Cameron, 1984, Pollard, et.al. 1974, Hooper 1974, Rackham 1986, Rands, 1987, Tew, 1994, Evans 1994) and the importance of hedgerows in the landscape cannot be disputed. In addition to serving their original purpose as stock-proof fencing, hedgerows also serve as windbreaks and shelter for crops and livestock, act as filters for nutrient runoff from agriculture, reduce soil erosion, may play a critical role in the hydrology of local watersheds, and provide a home for beneficial destroyers of crop pests, such as songbirds (Parish et al. 1994, Muir & Muir 1987, Arnold 1983) and predatory insects (Pollard 1968, 1971). The autumn fruiting of various hedgerow shrubs coincides with the migration movements of many songbirds, supplying them with much-needed energy; and the dense woody growth provides effective cover and nesting sites for resident birds. The hedge bottom is home to animals of field and forest such as foxes, badgers, hares, rabbits, hedgehogs, weasels, rats and mice, all of which may burrow in the hedge-bank. In agricultural regions, hedgerows act as reservoirs of biodiversity in an otherwise impoverished landscape (Walker et al. 2006). Hedgerow trees are often the only trees around for miles and the field boundary itself is the only natural or semi-natural vegetation in a man-made monoculture of improved grassland or cropland, thus relieving an otherwise monotonous landscape and producing the 'patchwork quilt' pattern so characteristic of the Irish landscape. Hedges may also support a mixed herbaceous flora containing species of grassland, wetland and woodland that have otherwise been removed from adjacent land by agricultural activities, but continue to survive in the hedgebank. Hedgerows therefore may act as refuges and corridors for the survival of native plant and animal species.

1.3 Structure & Composition of Hedgerows

1.3.1 Woody Species

In contrast to Britain, the paucity of hedgerow studies in Ireland does not allow for a clear picture of the form, species arrangement and condition of hedgerows on a nation-wide scale. A proposed national framework for surveying hedgerows in Ireland has been developed (Murray 2003) and recent work in eastern and midland regions of the country has revealed that the hedgerows in these areas are generally mixed hedges comprised of fruiting shrubs, predominantly Whitethorn (*Crataegus monogyna*), but also Blackthorn (*Prunus spinosa*), Elder (*Sambucus nigra*), and Wild Rose (*Rosa canina agg*.). These in turn, often support climbing fruiting shrubs or vines such as brambles (*Rubus fruticosus* agg.), Honeysuckle (*Lonicera periclymens*), Bittersweet Nightshade (*Solanum dulcamara*) and the ubiquitous ivy (*Hedera helix*).

Ash (*Fraxinus excelsior*) is a tree commonly found in Ireland as a hedgerow standard, but is also just as often kept in a shrubby form by repeated trimmings. Other trees that may be found in eastern hedges include Oak (*Quercus robur, Quercus x rosacea*), the native Wych elm (*Ulmus glabra*) and other non-native Elm species (*Ulmus procera, U. minor, U. x hollandica*), Birch (usually *Betula pubescens*) and the non-natives Beech, (*Fagus sylvatica*) and Sycamore (*Acer pseudoplatanus*) (Doogue & Kelly 2006, Doogue 1994, Murray & Foukes 2005a, 2005b, 2005c, 2005d, Murray 2001).

1.3.2 Herbaceous species

The herbaceous flora found at the base of these hedgerows is generally a mix of grassland and arable species at its margins, with ivy, ferns and other shade-tolerant species found in its interior. For a variety of historical and ecological reasons, woodland specialists are seldom encountered in eastern Irish hedgerows. Doogue (1998) comments on this ‘rarity of woodland elements in the herbaceous flora of north County Dublin’ adding that ‘the same scarcity applies to species that are capable of forming hedges’ (ie. woody species).

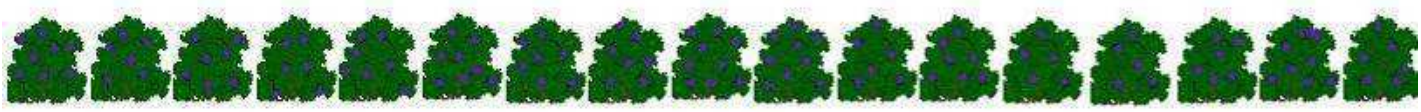
1.3.3 Hedgerows as reserves of woodland plants

The potential function of hedgerows as refugia for woodland plants has been the subject of ongoing study, and research on the woodland flora of hedges and their ability to colonise hedgerows has been carried out in Britain (Smart et al. 2001, McCollin et al. 2000a, Boatman et al. 1994, Helliwell 1975, Pollard 1973), Continental Europe (Endels et al. 2004) and North America (Roy & de Blois 2006, Corbit et al. 1999). While hedgerows may contain woodland species, many woodland specialists may not be present and the causes determining their presence or absence are not clear. Possible factors include the history and origin of the hedge (e.g. woodland assarts vs. those created in an open field setting), size, structure, management, adjacent land use and environmental variables such as aspect, soil moisture, nutrient content and pH. Archival sources and old maps may help to give a picture of past management practices and land uses, thereby enabling inferences to be made on the present-day species composition of hedgerows (McCollin et

al. 2000b, Hegarty & Cooper 1994). The importance of hedges as refuges for woodland biodiversity is augmented by the fact that Ireland, even more than Britain, is depauperate of much of the native woodland that is its potential natural vegetation (Cross 1998, 2006). Approximately 9% of Ireland is covered by forest, but less than 1% of the island is native broadleaved forest (Higgins et al. 2004). Since hedgerows are estimated to cover an area roughly three times that of deciduous woodland on an island-wide basis (Webb 1985), they may play a critical role in the preservation of woodland species. Fingal, with a long history of agriculture and settlement, has very little native woodland cover remaining, and therefore the hedgerows of the region are likely to be particularly important as habitat for native species. Too often, they are virtually the only habitat on many farms.

1.3.4 Management Practices and Adjacent Land-Use

Research has shown that the way hedges are managed in the landscape and the nature of adjacent land use may play a large role in determining their species composition (Hegarty & Cooper 1994). Roadside hedges and hedges that coincide with townland boundaries, for example, tend to be richer in woody species than those that divide fields within the townlands, but this effect can be masked by differences in management practices. A hedge that is frequently cut to a short distance from the ground will see an increase in light–demanding woody and herbaceous species as well as species that lend themselves well to shaping, as Whitethorn and Blackthorn do. Hedges in tillage areas and along roadsides are often managed in this way, possibly to facilitate the view of crops or ameliorate the “tunnel affect” that hedgerows can have along Irish roads, thereby making them less dangerous to drivers. Hedges that are neglected and allowed to grow tall, however, will see a decrease in light-demanding shrubs and herbs as the larger trees shade out those below. If not properly managed, such a hedge may become gappy and lose its function as a stock fence or windbreak, becoming a line of trees. Flora and fauna of woodlands may find refuge in the shade beneath, provided that the hedge is not heavily grazed by animals or mowed by machine. The width of a hedge may also be an important determinant of species richness and composition. Wider hedges are likely to support more species than narrow ones, and this effect can be further enhanced if a wide margin accompanies the hedge itself. The interior of a wide hedge is also likely to see reduced environmental stresses such as wind, drying, nutrient runoff and pollution, and therefore mimic the interior of woodlands in this respect. It is postulated that wide hedges that are moderately managed are highest in species diversity and the most likely habitat candidates for colonization by woodland species.

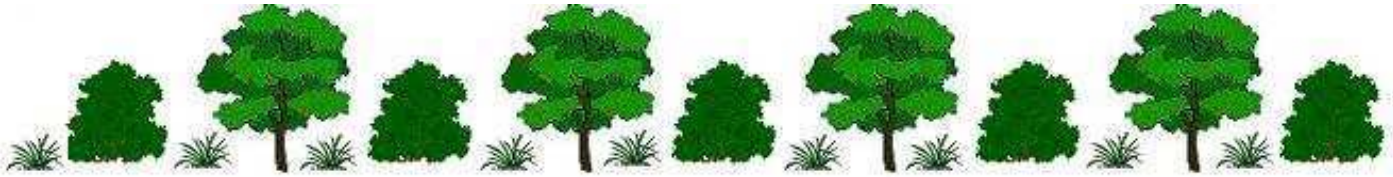


1.4 History of Hedgerows in the Dublin Region

Hedgerows have a long history in the Irish landscape, and the discovery of a prehistoric countryside of rectangular field systems beneath blanket bog at Behy, in County Mayo suggests that they may have been around since Neolithic times (Caulfield 1978, Mitchell & Ryan 2003). Although the Gaelic system of communal land ownership would have reduced the need for property delineations, provisions were still made for the control of wandering livestock and the protection of crops from depredation by animals, both wild and domestic. Early Irish law-texts often give detailed descriptions of the proper layout of areas under cultivation and pasturage, and these include fences and field boundaries which, like those of today, consisted of a ditch (*clas*) and bank (*múr*) The bank may have been intentionally planted with shrubs and trees, or these may have sprung up on their own through natural colonisation where grazing pressure was low (Kelly 1997, Binchy 1978).

The Anglo-Norman invasion of the 12th century would result in the decline of the Gaelic system and the consolidation of private land ownership in Ireland. With the establishment of the feudal system, enclosure of the Irish countryside became more organised, especially within the eastern counties of Dublin, Meath and Kildare that made up most of the region known as the "English Pale." The townland became the principal unit of land ownership by medieval times and may have been delineated using natural features such as standing stones, trees, rivers and streamcourses, or artificial features such as banks, roads, lanes, hedges and ditches (Kelly 1997, Otway-Ruthven 1951).

The Tudor plantations of the 16th and early 17th centuries, the Cromwellian re-conquests, and the "Agricultural Revolution" of the eighteenth century saw extensive land reform and some agricultural improvements, mainly on larger farm estates in the province of Leinster. These improvements included land-clearing, field enclosure and tree planting, which were also enshrined in many parliamentary laws of the period. Enclosure reached its zenith in the 18th century, while the early 19th century saw further enclosures up until the Famine period. The modern hedged landscape of Ireland may therefore be a relatively recent imposition on a formerly more open landscape. Older field divisions and townland boundaries may be fossilized among the later enclosures, and documentary evidence exists to suggest that many field margins, if not the hedges they contain, survive from an earlier date (Simington 1931-61, Feehan 1983). These older boundaries may support relic woodland species, slow-to-establish species and species of old grasslands that have escaped the plowing and other farming activities in adjacent fields, and therefore may be of greatest importance in schemes aimed at the conservation of hedgerow and woodland biodiversity.



SURVEY AIMS AND OBJECTIVES

2.0 Need for a Hedgerow Survey in Fingal

Prior to the current survey, there was no adequate information regarding the nature, extent, and condition of Fingal's hedgerows and the threats they currently face. As Doogue (1998) states, "Unfortunately, no inventory of hedges of high ecological significance has been compiled for the Dublin area." To correct this deficiency and fulfill part of the local biodiversity assessment, this survey attempts to catalogue the higher plant species found in hedgerows across the county and recommend appropriate management and conservation measures to maintain, and where appropriate, to increase the biodiversity of hedgerows in the region, thus ensuring the sustainability of this resource.

2.1 Objectives

The objectives of the Fingal hedgerow survey are as follows:

- To assess the species composition of higher plants in the hedgerows of the region;
- To create a baseline for future hedgerow surveys and monitoring through the creation of permanent plots using GIS mapping technology;
- To compare hedgerows in terms of their history, management, size and environment;
- To identify the major threats to the hedgerows of Fingal and make recommendations for future management
- To provide information on the plant diversity of hedgerows to aid local authorities in planning and conservation measures;

These objectives are in accordance with the guidelines established by the 2002 National Biodiversity Plan (NBP) which mandates that "all (government) sectors and actors (including local authorities) are responsible for advancing the conservation of biological diversity." Implementation of the NBP requires each sector to come up with "Action Plans" by which areas of high conservation interest within the jurisdiction of that government agency may be protected and species diversity enhanced. In Fingal (North County Dublin), a biodiversity audit was initiated in 2003 by the County Council's Parks Division as part of Fingal's Local Biodiversity Action Plan Programme, and a number of researchers were recruited to investigate the ecology of local habitats in the district. The current hedgerow study is part of several surveys to catalogue the biodiversity of habitats in Fingal.

The NBP recognises the importance of hedgerows in section 2.27 which states that "Field boundaries, mainly hedgerows, are a particularly prominent feature of the Irish countryside and provide important habitat for a variety of species. Hedgerows have suffered significant losses. Current legal controls for their protection are limited. For the future, the goal should be to have no net loss of the hedgerow resource" (*Department of the Environment 2002*).

Fruits of the wild Dog Rose (Rosa canina agg.) in a hedge near Curragh East

FIELD SURVEY & METHODOLOGY

3.0 Site selection

The methodology used in the hedgerow survey follows that used by Doogue (1994), based on earlier studies in Britain (Pollard et al. 1974, Moore et al. 1987), further developed by Foulkes & Murray in the Irish National Hedgerow Survey Methodology (2003) and used in their subsequent surveys of counties Roscommon (2005a), Westmeath (2005b), Laois (2005c) and Offaly (2005d). In the sampling method, which also follows the Badger and Habitat Survey of Ireland (Smal 1995), a 1km² grid in the bottom left-hand corner of each 100 km² (10 km x 10 km) OSI grid square is selected and, where possible, 10 hedges randomly sampled throughout the kilometre square. Applying this method, only 5 stratified 1km squares were originally produced for study in Fingal (Figure 3). The bottom left-hand 1km² of each 100 km grid square is often not possible to sample in Fingal due to the crossing of county boundaries, the presence of urban development, or the absence of sufficient vegetation cover. The square immediately to the right (east) of the initial selection was selected instead. Due to the difficulty in finding 10 hedges per square kilometer, the number of sample sites was increased to 4 per 10 km² (one site every 5km) instead of 1 site per 10 km² (Figure 3) and the number of hedges sampled per site was reduced from 10 to 5. With the aid of aerial photos and maps the hedges were selected in advance and were based on pre-established criteria (Table 3). Where feasible, permission from the landowners was also obtained beforehand. In this manner, 25 1km² sites were produced for study in Fingal, with a *potential* of 125 hedges for study. The actual number of hedges surveyed (82) was significantly less than the potential, owing chiefly to factors such as urbanisation (5 sites), the paucity of hedges in coastal areas of the county (3 sites), and more rarely, being turned away from sites by landholders (3 sites).

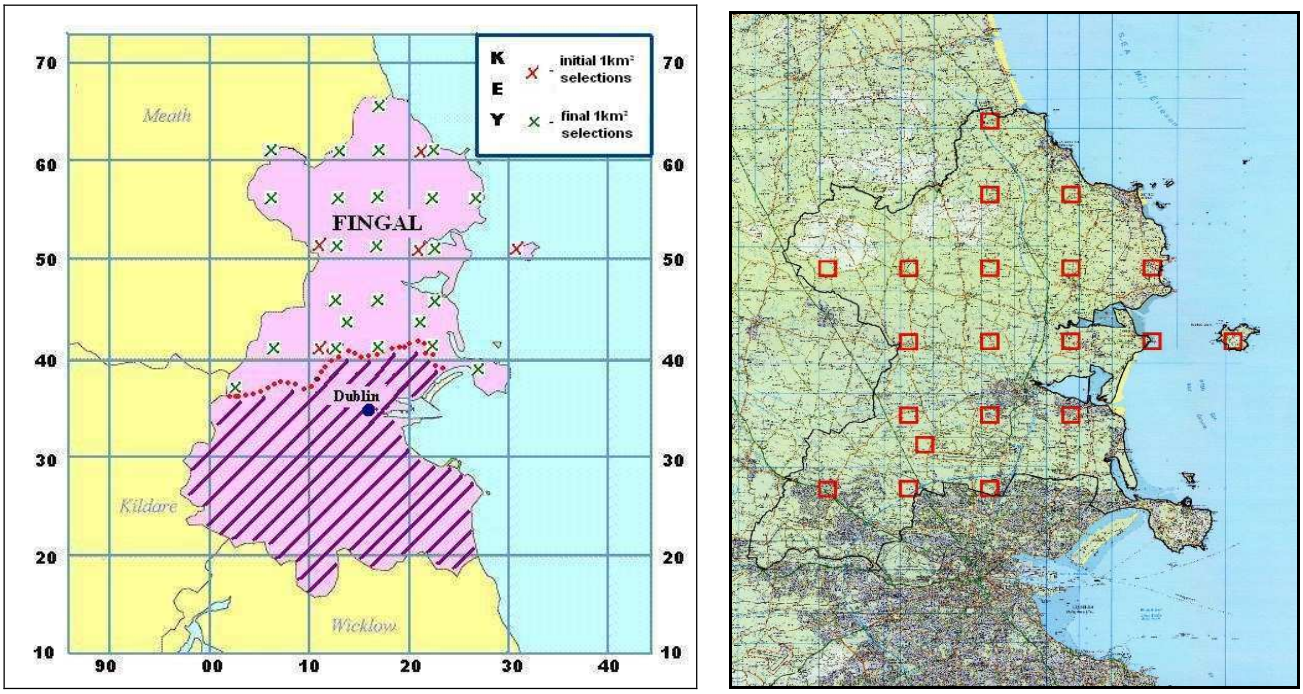


Figure 3. Irish Grid maps of Dublin County showing the distribution of sample 1km²

in the Fingal region (*OSI Ireland*)

3.1 Aerial Photos and Maps

Orthostat Aerial photos, early edition Ordnance Survey Ireland maps (1837-1931) (scale 6 inch: 1 mile) and Discovery Series maps (scale 1:10,560) were used to locate all existing hedgerows within each 1km sample square of the Irish National Grid. Altitude was estimated from the OSI Discovery Series maps. Townland and parish boundaries were located within the selected squares on early edition OSI maps obtained from Fingal County Council's GIS database. The maps and photos were also used to locate natural and artificial features such as rivers, streams, woodland, quarries, residential areas and anything nearby that might influence the species composition of the hedges under study.

3.2 Methods of Selecting Hedges for Study

The criteria for the selection of hedgerows for sampling in the field closely follows that of Doogue and Kelly (2006) in which hedges are "defined as linear, free-standing shrub and tree assemblages, usually functioning as field boundaries." Field boundary types excluded from both studies were (1) field margins or tree-lines comprised of mature shrubs/trees (usually *Fagus sylvatica*) that had been planted as avenues or windbreaks; (2) Hedges where trimming was so severe that reliable species counts were not possible; (3) self-sown linear scrub features adjoining old walls, and (4) ornamental hedges associated with present-day dwellings, mainly comprised of *Ligustrum ovalifolium*, or cypresses (*Chamaecyparis* and *xCupressocyparis* cultivars) (Doogue & Kelly 2006).

Along with roadside hedges, townland boundary hedges were sampled for comparison with the inter-field hedgerows that divide the interior of townlands. Where possible, one townland boundary hedge, one roadside hedge, one inter-field hedge, 1 streamside hedge (if present) and one "other" were selected from aerial photos and maps prior to ground sampling for a total of five sampled hedges per km² in all (Figure 3.1, Table 3). For the "other" category, one hedge adjacent to other features such as a track, woodland, park, quarry etc. was to be selected, if present in the kilometre square. Where streamside hedges and "other" hedges were absent, another inter-field or townland boundary hedge was chosen at random for sampling.

Hedge Type	**Townland Boundary**	**Roadside**	**Interfield**	**Streamside**	**Other**	TOTAL
Number per km² to be sampled	**1**	**1**	**1**	**1**	**1**	5
Total number to be sampled in all	**25**	**25**	**25**	**25**	**25**	125

Table 3. The criteria for pre-selection of hedges prior to the ground survey.

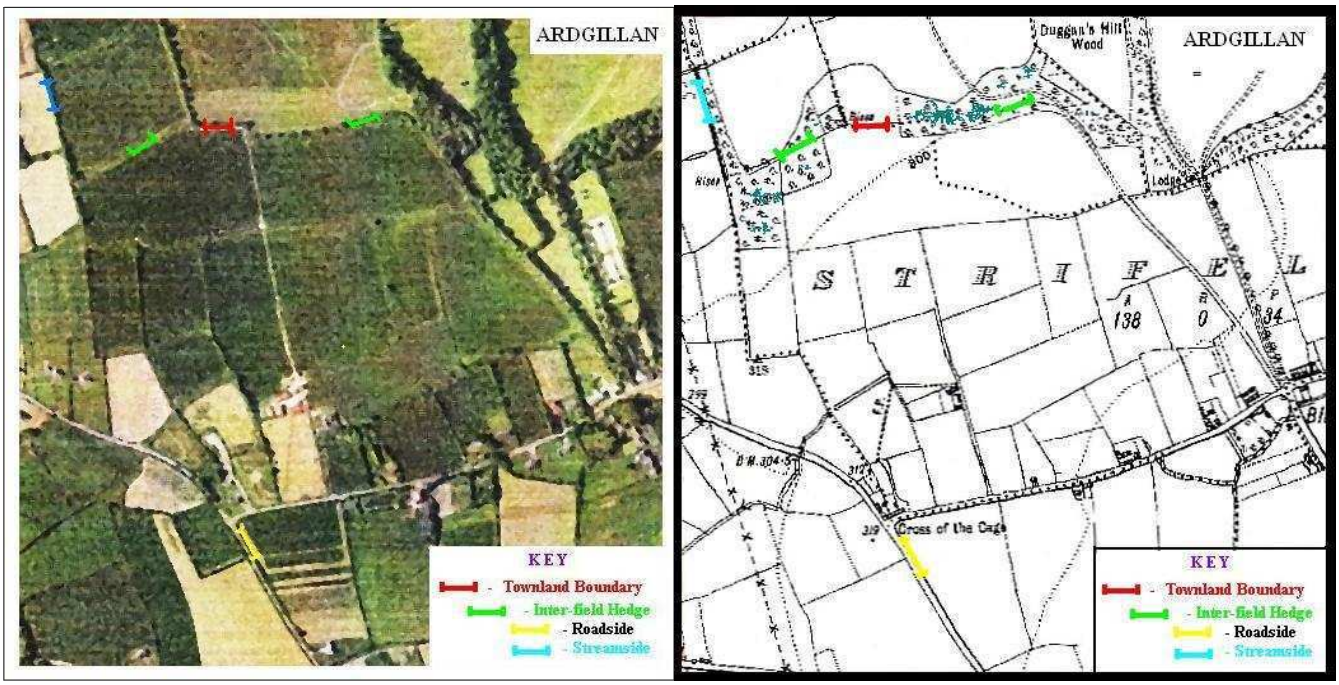


Figure 3.1. Aerial orthostat photo and accompanying first edition OSI map of a 1km² sample square used to locate hedgerow samples prior to ground survey. A townland boundary hedge length to be sampled is denoted in red, a streamside hedge in blue, a roadside hedge in yellow and two inter-field hedges in green.

3.2.1 Woody Species

For each hedgerow, single 30-meter samples were produced from randomly selected points along the hedgerow, provided that the points were at least 15 meters from the nearest major change in the hedge (i.e., another bisecting hedge, adjacent woodland, gate, drive, house, etc) (Doogue 1994). GPS coordinates were logged for these points to be later added to a GIS database/overlay to map the hedges. All shrub and sapling species were recorded and their cover estimated using a percentage scale, to be later converted to the Braun-Blanquet or Domin scale as needed. Large standard trees where they occurred along the 30 m sample also had their height and girth recorded. The location of, and distance to the nearest woodland was likewise noted.

Structural features to consider included:

- species composition and cover
- hedge height, width & density (“gappiness”)
- the presence/absence of large trees
- presence/absence of ditches and banks, stone walls, and additional fencing
- condition and age of hedgerow
- fruiting abundance (using *Crataegus* flowers or fruit as indicator)

These were all to be recorded on field survey sheets using pre-established scales.

3.2.2 Herbaceous Species

For each of the 30 m quadrats produced in recording the woody species of the hedgerow, individual 10 metre quadrats were sampled from each side and the interior (where possible) of the 30 meter hedge section in a "nested sample" design (Figure 3.2). Some variation in the width of the sampling size occurred due to differences in the width of the hedgerow and in the extent of the hedge-bottom vegetation as a result of factors such as grazing, mowing, shade, the presence of an adjacent road, etc… Due to these variations in hedgerow size, the width of each quadrat measured would vary between 0 m and 7 m, (to the nearest 0.5 m) with the majority falling between 0.5 m and 3m. All herbaceous species within each sample were then recorded; percent cover values were estimated for each, to be converted to the Braun-Blanquet scale, and species diversity was calculated.

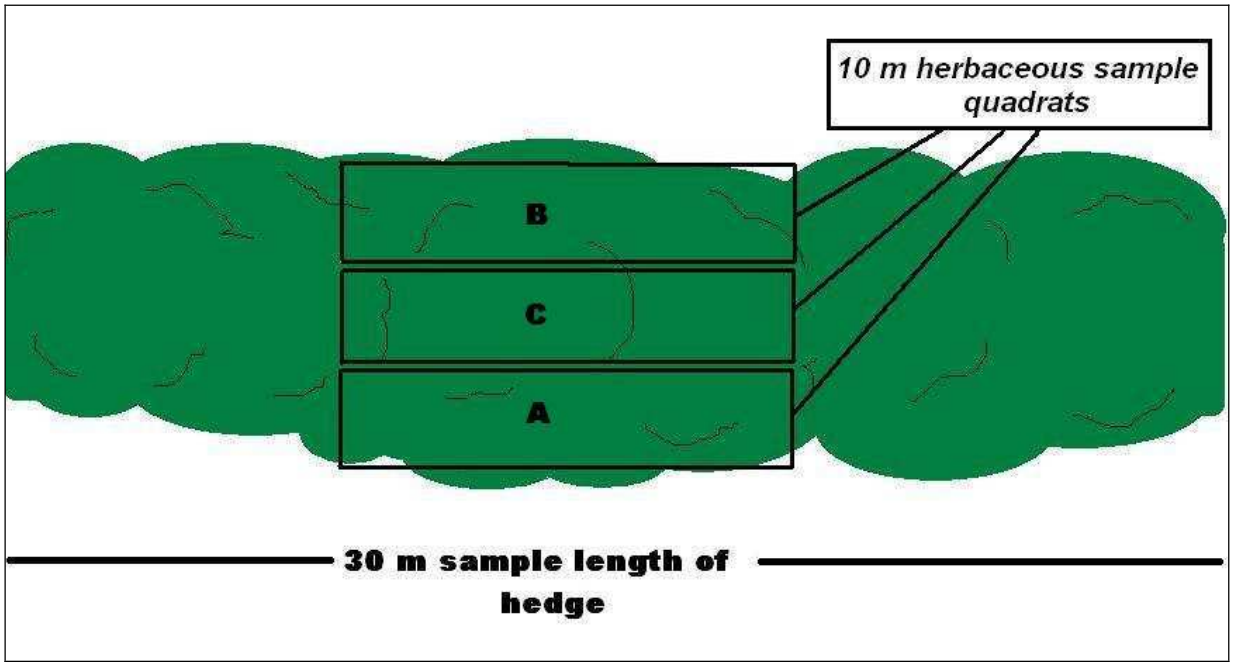


Figure 3.2. Diagram of "nested sample" method used to survey herbaceous species within each 30m woody species quadrat.

3.2.3 Environmental Variables

A number of environmental variables were also recorded in the survey. Among those possible, the focus was on the following:

- Location of the hedge (ie, roadsides vs. inter-field hedges/ townland boundaries)
- Altitude
-Aspect and linear direction of the hedge
-Soil pH
- Links with other habitats
- Presence/size of ditch and bank
- Subjective "wetness" scale of surrounding landscape [ranking 1 (dry) to 5 (saturated)]
- Hedgerow management (or lack thereof)

3.2.4 Soil Analysis

For all sample quadrats, $5cm^3$ samples of soil were taken from the hedgebank, as near as possible to the center of the 30 m quadrat. These samples were then labeled and tested as soon as possible for pH values, using a 1:1 soil to water paste tested with a glass electrode pH meter.

3.2.5. Management regimes

The management of hedgerows and the surrounding landscape has a profound impact upon species content and richness, therefore management regimes and adjacent land-use were also observed and recorded (Hegarty & Cooper 1994, Peterken & Game, 1984). Where possible, this information was also supplemented from the landowner, through the medium of conversation. Factors considered in hedgerow management include:

- frequency of cutting
- method used (ie, flail, circular saw, hi-mac, hand-cut, other, none)
- evidence of hand-laying (past or present)
- function of the hedge as an active boundary
- Herbicide use
- Litter/dumping
- Any record of past management regimes

Adjacent land uses (pasturage, tillage, road, paved track, grassy track, wood, lawn) were also assessed and recorded since these factors all may influence the structure and vegetation composition of the hedgerow, as well as the nature of the hedge-bottom flora (Hegarty & Cooper 1994).

Old Whitethorn showing evidence of being managed by laying in the past. Note the "elbows" that are characteristic of laid hedges. Charstown, northern Fingal.

DATA ANALYSIS

4.0 Aerial Survey Photos and OSI Maps

From the GIS data and maps, critical determining factors influencing the vegetation, especially the herbaceous vegetation, were analysed. These include the extent of their coincidence with townland and parish boundaries, geographical features, and the distance to the nearest extant woodland. Other features such as aspect and altitude can be determined from the maps, and estimates of average hedgerow density per square kilometer were also determined.

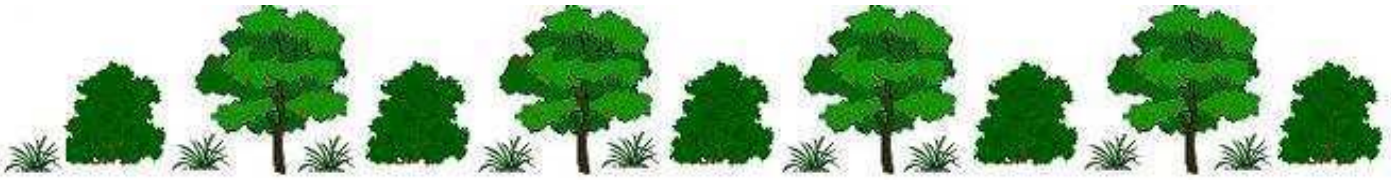
4.1 Statistical Analysis

To test the hypothesis that townland/parish boundary hedgerows and roadside hedgerows are more species-rich than non-townland boundary and inter-field hedgerows, an ANOVA test is used to analyse relationships between a species and other species in the community, as well as against the environmental variables (Kent & Coker 1992). Although simple percentages are given in this report, ANOVA tests can also be used to analyse the number of woodland species found in hedgerows in relation to non-woodland species, with "woodland species" in this case, being defined according to Doogue (1998) and Colgan (1904) for County Dublin, as well as Peterken (1974, 1981, 1993, 2000) for the British Isles as a whole.

4.2 Ordination and Classification of the flora

During analysis, the variations within vegetation communities of hedgerows and woodlands, as well as relationships between the vegetation and its environment were assessed using Detrended Correspondence Analysis (DCA) (Hill 1979a) as an indirect multivariate ordination technique. Major sources of variation within the plant communities themselves were analysed before relating the communities as a whole to environmental factors including aspect, hydrology, soil pH, as well as biotic factors such as grazing levels and management.

From the species data, habitat distinctions and plant communities were analysed using the software package PC-ORD (McCune and Mefford 1999) which utilises objective classificatory techniques such as TWINSPAN (Hill 1979b).With this technique, plant communities are classified and ranked according to the frequency in which certain "indicator" species occur. The resulting community patterns will be interpreted in relation to abiotic environmental influences (wetness, pH, and biotic influences such as grazing and management practices (or lack thereof).



RESULTS

5.0 The Extent of hedgerows in Fingal

In this study, approximately 26 km² of the Fingal's 455 km², or nearly 5.7% of the district, was surveyed. If this 5.7% represents the region as a whole, then Fingal can be estimated to have a hedgerow length of 2,660 km. This gives an average density of 5.83 km/km² with a standard deviation of 4.001 (Table 5).

Grid Ref.	Name of Square	Description	Area (km²)	Hedgerow Length (km)	Density (km/ km²)
O 21 60	Lambay Island	Coastal	1	0	0
O 20 55	Malahide	Urban/Suburb	1	0	0
O 06 55	Mulhuddart	Urban	1	0	0
O 16 60	Portraine Quay	Coastal	1	0	0
O 11 59	Santry Demesne	Urban	1	0	0
O 16 50	Howth (Binn Eadair)	Coastal/Urban	1	0.9	0.9
O 16 65	St Catherine's	Suburban	1	2.5(2 Fingal, 0.5 S. Dublin)	2.5
O 16 45	Hilltown/Forrest	Suburban	1	3	3
O 07 43	Rush Demesne	Coastal	1	3.1	3.1
O 27 38	Newbridge/ Turvey	Suburb/Demesne	1	3.9	3.9
O 21 50	Kildonan	Urban	1	5	5
O 11 45	Hollystown	Suburban	1	5	5
O 06 60	Dollards	Rural	1	6.9	6.9
O 26 55	St Margarets	Rural	1	7	7
O 02 35	Curragh West	Rural	1	8.2	8.2
O 12 43	Newpark	Rural	1	8.3	8.3
O 16 55	Fieldstown	Rural	1	8.6	8.6
O 11 55	Abbeyville	Suburb/Demesne	1	9.1	9.1
O 20 43	Charstown/Ballymadun	Rural	1	9.1	9.1
O 11 51	Causestown/Lusk	Rural	1	9.2	9.2
O 11 40	Ardgillan/Strifeland	Rural/Demesne	1	9.6	9.6
O 31 50	Wimbletown	Rural	1	9.9	9.9
O 21 45	Gormanston/Tobersool	Rural	1	10	10
O 06 40	Wyanstown	Rural	1	10.2	10.2
O 26 50	Curragh East	Rural	1	10.4	10.4
O 16 4	Pluckhimin/Ballymuck	Rural	1	11.6 (6.2 Fingal, 9 Meath)	11.6
Totals			26	152.3	Average = 5.83 (Standard dev 4.001)

Table 5.1 Extent and Density of Hedgerows in Fingal's 1 km² sample squares

It can be seen from the data in Table 5.1 that urban and coastal areas of Fingal have the lowest density of hedgerows while rural areas to the north and west have the highest density. The density in the sample squares varies from 0 in five squares (Lambay Island, Malahide, Mulhuddart, Portraine and Santry) to 10.4 km/km² (Curragh East) and 11.6 km/km² (Pluckhimin).

As illustrated in Table 5.2, the average density of 5.83 km/km² of hedgerows in Fingal compares favorably to surveys completed for the Irish counties Offaly (Foulkes & Murray 2005d), Westmeath (2005a) and Roscommon (2005b), and in Leinster, to counties Kildare and Wicklow, as reported in the Badger & Habitats Survey of Ireland (Smal 1995). The density of hedgerows in Fingal is however, much lower than in the neighboring county of Meath, where a mean hedgerow density of 9.33km/km² is recorded (Smal 1995). Overall, these figures are much higher than average densities found in Britain where the general density of hedges in lowland England is estimated to be 2.91 km/km² (Barr 1993). Likewise, in continental Europe, studies at the local level have assessed hedgerow densities of 4.0 km/km² (40m ha^{-1}) for northeast Belgium (Deckers *et al*. 2005) and 3.9 km/km² (39 m ha^{-1}) for parts of Denmark (Levin, G. *et al*. 2006).

It must be noted, however, that during the Fingal survey no distinction was made between hedgerows and treelines in estimating the length of hedgerows in the region. This is due to time constraints and the difficulty of distinguishing between the two types of linear features on aerial photos. Treelines are generally single lines of well-spaced, planted trees (commonly Beech) which were never intended to function as a stock-proof boundary or have grown out of long extinct hedgerows. In keeping with the methodology used by Foulkes & Murray, nevertheless, garden hedges and obviously planted windbreaks and laneways were excluded from the measurements (and the survey), as were vegetated ditches, banks and walls from which woody species were absent (2005, a,b,c,d). Unlike the current report and the reports for Laois, Offaly, Roscommon and Westmeath, treelines were recorded as separate features in the Badger & Habitats Survey (Smal 1995); they are combined with hedgerow densities in Table 5.2 for comparison purposes. Data for Northern Ireland were obtained from the Northern Ireland Countryside Survey 2000 (Cooper & McCann 2002).Caution must be exercised, however, when making direct comparisons between the Badger & Habitat Survey results and more recent data as a major discrepancy was discovered by Foulkes & Murray (2005b) between their findings for Roscommon and the Badger survey data for the same county.

Republic Of Ireland				***Total average hedgerow density (Smal 1995)***				**5.7**
Northern Ireland (UK)				***Total average hedgerow density (NICS)***				**8.8**
COUNTY/ REGION	**Average Hedge Density (km/km²)**	**Avg. Treeline Density (km/km²)**	**Year of survey**	**Total Average Density (km/km²)**	**Average Hedge Density (km/km²)**	**Avg. Treeline Density (km/km²)**	**Year of Survey**	**Total Average Density (km/km²)**
LEINSTER								
FINGAL		included	**2006**	**5.83**			**2006**	**5.83**
Dublin (all)	**-**	**-**	**-**	**-**	5.22	1.62	1989-93	**6.84**
Laois	7.28	included	2005	**7.28**	6.98	0.72	1989-93	**7.70**
Offaly	5.81	included	2005	**5.81**	4.48	1.61	1989-93	**6.09**
Westmeath	5.82	included	2005	**5.82**	4.47	1.64	1989-93	**6.11**
Carlow					5.39	0.74	1989-93	**6.13**
Kildare					3.26	2.53	1989-93	**5.79**
Kilkenny					9.97	0.99	1989-93	**10.96**
Longford					6.06	1.05	1989-93	**7.11**
Louth					8.03	0.66	1989-93	**8.69**
Meath					6.67	2.66	1989-93	**9.33**
Wexford					8.13	1.59	1989-93	**9.72**
Wicklow					4.12	0.75	1989-93	**4.87**
ULSTER	**NICS2000 data (Cooper & McCann 2002)**							
Mountain districts								
Antrim Coast & Glens	2.8	-	1998	2.8				**2.8**
Mournes	3.5	-	1998	3.5				**3.5**
Sperrins	2.4	-	1998	2.4				**2.4**
North Derry	2.4	-	1998	2.4				**2.4**
Donegal (Rep.)	-	-		-	2.02	0.60	1989-93	**2.62**
Lowland districts								
Slieve Gullion/ Armagh	10.8	-	1998	10.8				**10.8**
Fermanagh District	10.1	-	1998	10.1				**10.1**
Wider Countryside	10.2	-	1998	10.2				**10.2**
Cavan (Rep.)	-	-	-	-	8.41	1.68	1989-93	**10.09**
Monaghan (Rep.)	-	-	-	-	9.07	1.28	1989-93	**10.35**
MUNSTER								
Clare					5.77	0.21	1989-93	**5.98**
Cork					6.63	0.67	1989-93	**7.30**
Kerry					2.63	0.39	1989-93	**3.02**
Limerick					7.50	0.20	1989-93	**7.70**
Tipperary					9.15	0.66	1989-93	**9.81**
Waterford					8.73	0.61	1989-93	**9.34**
CONNAUGHT								
Galway					2.20	0.34	1989-93	**2.54**
Leitrim					5.73	1.46	1989-93	**7.19**
Mayo					1.34	0.26	1989-93	**1.60**
Roscommon	5.43	combined	2005	**5.43**	3.81	0.92	1989-93	**4.73**
Sligo					4.34	0.89	1989-93	**5.23**

"included": *Treelines are included in estimates of hedgerow density, unlike the Badger Survey (Smal 1995), which recorded them separately.*

Table 5.2. Comparisons between average hedgerow density obtained from the Fingal survey and those obtained for other counties in the Republic of Ireland and Northern Ireland.

6.0 Species Composition of Fingal Hedges

6.1 Trees

The most commonly encountered tree in Fingal hedgerows is the ash (*Fraxinus excelsior*) (Table 6.1). This was also discovered to be the case in Foulkes & Murrays' surveys of Laois, Offaly, Roscommon, and Westmeath (2005, a,b,c,d). Besides Ash, other common trees found in Fingal hedges are the non-native Sycamore and suckering elms (*Ulmus x hollandica, U. minor, U. procera*). With the exception of the native Wych Elm, where elms occurred, they tended to dominate at least one-fourth of the hedge sample, as illustrated by their high mean abundance levels (Table 6.1, Figure 6.1). Oak and Sally (*S. cinerea*) are frequently encountered in Fingal hedges at low abundance levels, while Wild Cherry is both frequent and locally abundant.

Tree Species	Irish Name	% Frequency	Mean Domin Abundance Levels
Common Ash *(Fraxinus excelsior)*	***Fuinseóg***	**65.85**	**6 (25-33% cover)**
Sycamore* *(Acer pseudoplatanus)*	***Seiceamar***	**30.49**	**4 (4-10% cover)**
Elm* *(Ulmus spp.)*	***Leamhán***	**19.5**	**6 (25-33% cover)**
Sally *(Salix cineria)*	***Saileach rua***	**14.63**	**3 (<4% cover)**
Wild Cherry *(Prunus avium)*	***Crann silíní fiáin***	**13.4**	**5 (10-25% cover)**
Oak *(Quercus robur & Q. x rosacea)*	***Dair ghalida***	**12.2**	**4 (4-10% cover)**
Beech* *(Fagus sylvatica)*	***Feá***	**7.32**	**5 (10-25% cover)**
Wych Elm *(Ulmus glabra)*	***Leamhán sléibhe***	**7.32**	**4 (4-10% cover)**
Apple* *(Malus domestica)*	***Crann úll***	**4.88**	**5 (10-25% cover)**
Crab-Apple *(Malus sylvestris)*	***Crann fia- úll***	**3.66**	**3 (<4% cover)**
Whitebeam (*Sorbus aria* agg.)	***Fionnchol***	**3.66**	**5 (10-25% cover)**
Goat Willow *(Salix caprea)*	***Sailchearnach***	**2.44**	**5 (10-25% cover)**
Hornbeam* *(Carpinus betulus)*	***Crann sleamhain***	**2.44**	**3 (<4% cover)**
Birch *(Betula pendula)*	***Beith geal***	**1.22**	**3 (<4% cover)**
Field Maple* *(Acer campestre)*	***Mailp***	**1.22**	**3 (<4% cover)**
Horse Chestnut* *(Aesculus hippocastaneum)*	***Crann cnó capaill***	**1.22**	**3 (<4% cover)**
***non-native tree species**			

Table 6.1. The frequency and abundance of tree species in sampled hedges of Fingal

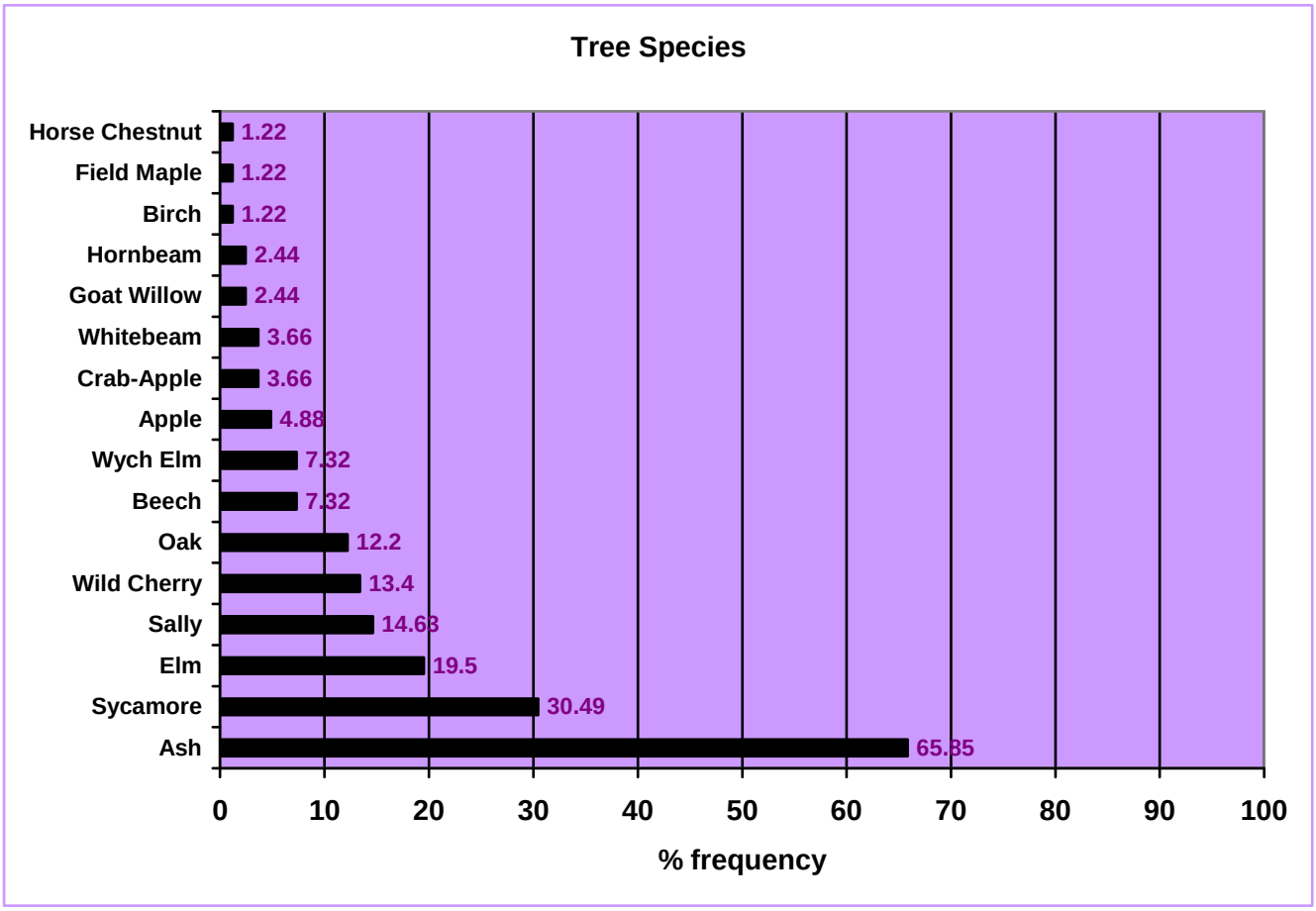


Figure 6.1. Frequency of tree species encountered in Fingal hedges

6.2 Rare and Uncommon Tree Species

Uncommon hedgerow tree species found in Fingal include Whitebeam (*Sorbus aria*); one young individual (~3 metres in height) was found in the Hilltown sample, near Swords (Plate 6.1). Two Whitebeam individuals found in 30 m hedge samples near Wyanstown and Hollystown were thought to be the native Irish Whitebeam (*Sorbus hibernica*), Ireland's only endemic tree species. The Wyanstown individual was a mature individual, and leaf and fruit samples collected for further study have since been expertly distinguished as *Sorbus hibernica* (John Parnell, pers.comm. 2007). Other uncommon trees found included Crab-apple (*Malus sylvestris*) at St. Catherine's and Wimbletown and Birch (*Betula pendula*) at Gormanstown.

Plate 6.1. Young Whitebeam (*Sorbus aria*) in a hedge near Hilltown.

Oak (*Quercus robur, Q. petraea and hybrids*)

Although Oak is common in the hedgerows of Britain, it is but an occasional tree in Irish hedges. Pedunculate Oak (*Quercus robur*) was found mainly as a shrub or small tree in hedgerows at Ardgillan, Dollards, Newbridge, and Wimbletown. At St Catherine's and Gormanstown (where it occurred just outside of the sample plots), it was a standard tree in the hedgerows. Although Sessile Oak (*Quercus petraea*) has historically been less commonly planted than Pedunculate Oak in Ireland, and is rare as a naturally occurring species on base-rich lowland soils, it was found at one site in this survey (HILL 5). The individuals at Hilltown were quite mature, with circumferences of 2.5 m or more at breast height and were situated along an old townland boundary.

Apple (*Malus domestica)* and Crab-Apple *(Malus sylvestris)*

Apple trees are not particularly common in hedgerows in County Dublin, and the native Crab is described as very rare (Doogue et al. 1998), however, in this survey, both taxa appeared to be abundant in the Wimbletown square of north-central Fingal. Nearly all of the hedgerows observed in this 1 km² had more than one *Malus* along its length. Confusion arose in differentiating between the domestic Apple and the Wild Crab at this site, as both individuals with hairy leaves and pedicels (domestic Apple) and those with glabrous leaves and pedicels (Wild Crab) were observed, often together in the same hedgerow. For the purpose of this study, those with small fruits and glabrous leaves were identified as *Malus sylvestris*, the Wild Crab while those with large fruits and hairy leaves and pedicels were labeled *Malus domestica*, the domestic Apple (Plate 6.2). More research is needed, as this unique site appears to be a critical reserve of healthy *Malus* genes in Ireland, and the apparent vigor of this population may be used for the propagation and conservation of wild Irish stock (Dudley & Hayes 2002). All size and age classes appear to be present, indicating naturalization. The population, however, is threatened by development, since active construction and hedgerow removal were observed to be taking place at this site. Hedges at Newbridge and St. Catherine's were also observed to have individual *Malus domestica.*

Plate 6.2. Images of an example of a Crab-apple (*M. sylvestris*) (L) collected from Wimbletown, and a domestic apple (*M. domestica*)(R) naturalised in a Wimbletown hedge.

6.3. Woody Shrubs

With nearly 99% occurrence in the sample sites, Hawthorn is the most common shrub in Fingal hedgerows, most likely reflecting its wide use as hedging material. Also common in Fingal hedges is Dog Rose (*Rosa canina* agg.), while Elder and Blackthorn occurred in nearly half of all the hedges sampled, and Gorse and Holly in nearly 25%. Additional woody species that may be present in the hedgerow include Damson (*Prunus domestica*), Privet (*Ligustrum vulgare*), Hazel (*Corylus avellana*), the non-native Snowberry (*Symphoricarpos albus*), and more uncommonly, Field Rose (*R. arvensis*), Tutsan (*Hypericum androsaemum*), Spindle (*Euonymus europaeus*) while Yew (*Taxus baccata*) also occurs, but only in shrub form. The frequency and abundance of these species can all be found in Table 6.3.

Woody Shrub Species	% Frequency	Mean Domin Abundance Levels	
Hawthorn *(Crataegus monogyna)*	98.78	7	(33-50% cover)
Dog Rose *(Rosa canina agg. & Rosa stylosa)*	89.02	4	(4-10% cover)
Elder *(Sambucus nigra)*	46.34	5	(10-25% cover)
Blackthorn *(Prunus spinosa)*	37.8	5	(10-25% cover)
Gorse *(Ulex europaeus)*	23.17	4	(4-10% cover)
Holly *(Ilex aquifolium)*	19.5	4	(4-10% cover)
Wild Privet *(Ligustrum vulgare)*	9.76	3	(<4% cover)
Field Rose *(Rosa arvensis)*	8.54	3	(<4% cover)
Hazel *(Corylus avellana)*	7.32	5	(10-25% cover)
Downy Rose *(Rosa sherardii)*	7.32	4	(4-10% cover)
Spindle *(Euonymus europaeus)*	6.1	5	(10-25% cover)
Damsons *(Prunus domestica)*	4.88	4	(4-10% cover)
Tutsan *(Hypericum androsaemum)*	2.44	3	(<4% cover)
Yew *(Taxus baccata)*	2.44	3	(<4% cover)
Snowberry* *(Symphoricarpos albus)*	1.22	3	(<4% cover)
Red Currant* *(Ribes rubrum)*	1.22	3	(<4% cover)
Wild Raspberry *(Rubus idaeus)*	1.22	3	(<4% cover)
Common Lilac* *(Syringa vulgaris)*	1.22	4	(4-10% cover)

Table 6.3. The frequency and abundance of woody shrub species occurrence in Fingal hedgerows.

Some shrubs of Fingal hedgerows. *Top row from left to right are Elder, Gorse, Spindle and Blackthorn. On the bottom row from left to right are Holly, Wild Privet, Hazel and Dog Rose.*

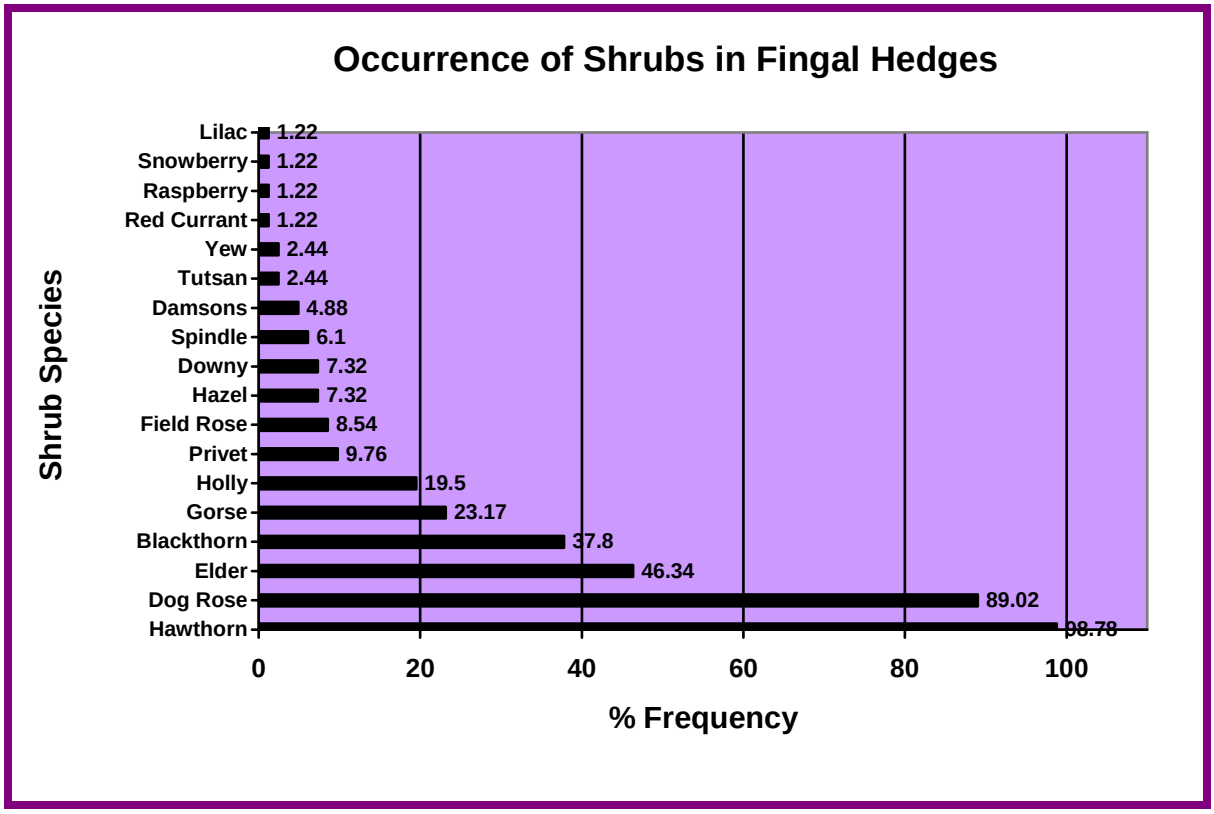


Figure 6.3. Frequency of shrub species in Fingal hedges**.**

6.4. Woody Species Richness

The total number of woody species identified in Fingal hedgerows is 43, of which 31 are native and 12 are non–native. As the simplest measure of biodiversity, species richness is a count of the number of species found in a defined area, or this case, each of the 30-meter hedge quadrats sampled within each kilometer square site in Fingal. A species-rich hedge in Ireland is defined by Foulkes & Murray (2005a,b,c,d) as one that contains 4 or more *native* woody species, a number adapted from the five or more used to define species-rich hedges in lowland Britain (HMSO 1997). Excluding Ivy (*Hedera helix*) and Bramble (*Rubus fruticosus agg.*.), and recording all *Rosa canina* aggregates, hybrids and micro-species as one, the hedges of Fingal were found to have an overall average of 4.9 woody species per 30 metre section of hedgerow, with a range between 1 species per hedge (Rush, Ardgillan) and the 14 species found in a hedge at St Catherine's (Figures 6.4, 6.4a, Table 6.4). When non-native species are excluded from the count (Doogue 1998), this number is reduced to an average of **4.2** species per hedge and a range of 1 (Rush, Ardgillan) to 12 native species at Gormanstown (Figure 6.4b).

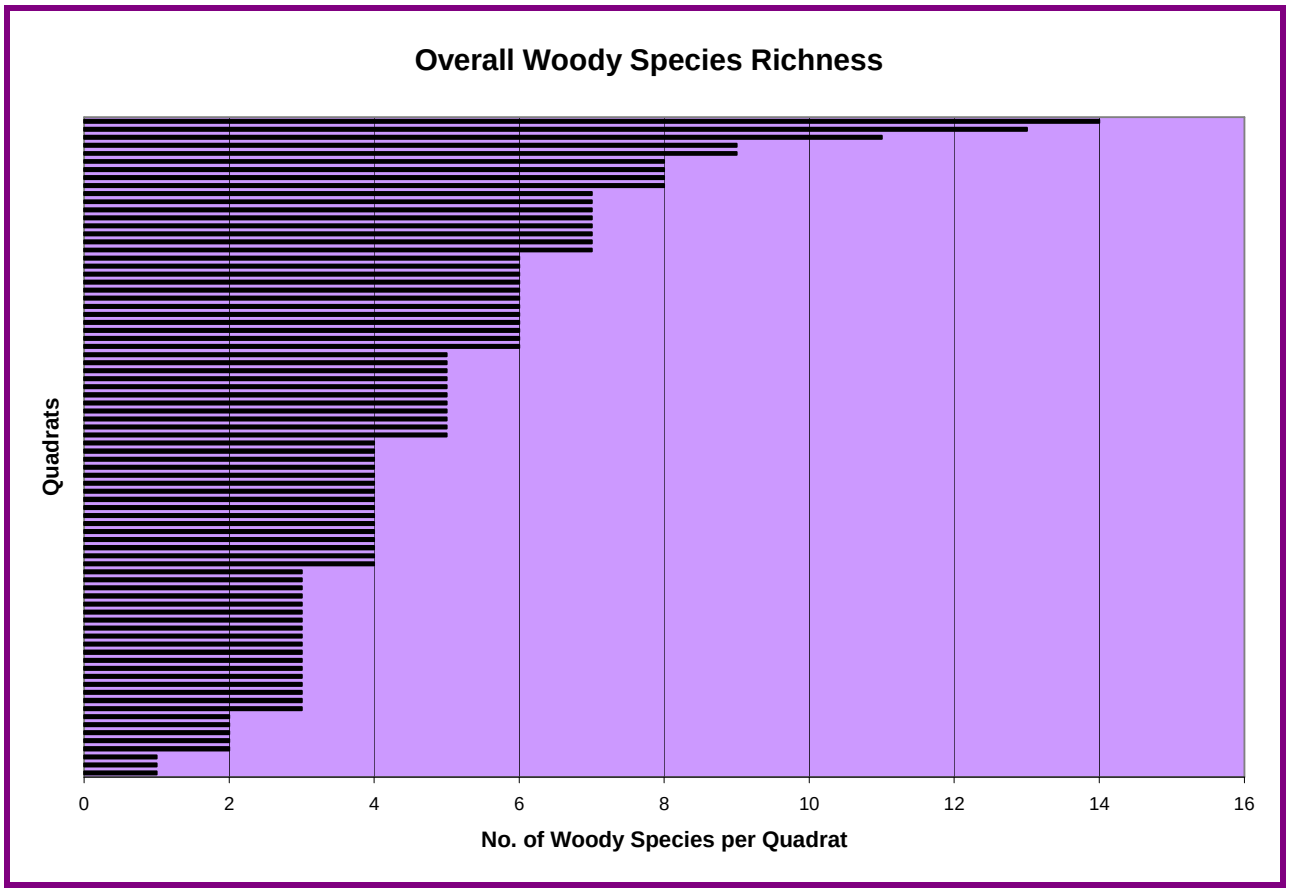


Figure 6.4a. The number of woody species identified per 30 metre sample of hedgerow. Mean species richness is 4.9 species.

Highest Species Richness		Lowest Species Richness	
Location/Hedge #	Number of Woody Species	Location/Hedge #	Number of Woody Species
St.CATHERINE'S 1	14	ARDGILLAN 5	1
GORMANSTOWN 3	13	RUSH 1	1
HOLLYTOWN 3	11	RUSH 3	1
HILLTOWN 1	9	CHARSTOWN 1	2
ARDGILLAN 4	9	ARDGILLAN 1	2
WIMBLETOWN 2	8	CURRAGH WEST 3	2
HOWTH 3	8	HOWTH 2	2
HILLTOWN 5	8	RUSH 2	2
ARDGILLAN 3	8	CAUSESTOWN 1	3

Table 6.4. Hedgerows with the highest and lowest woody species richness per 30 m sample in the survey area.

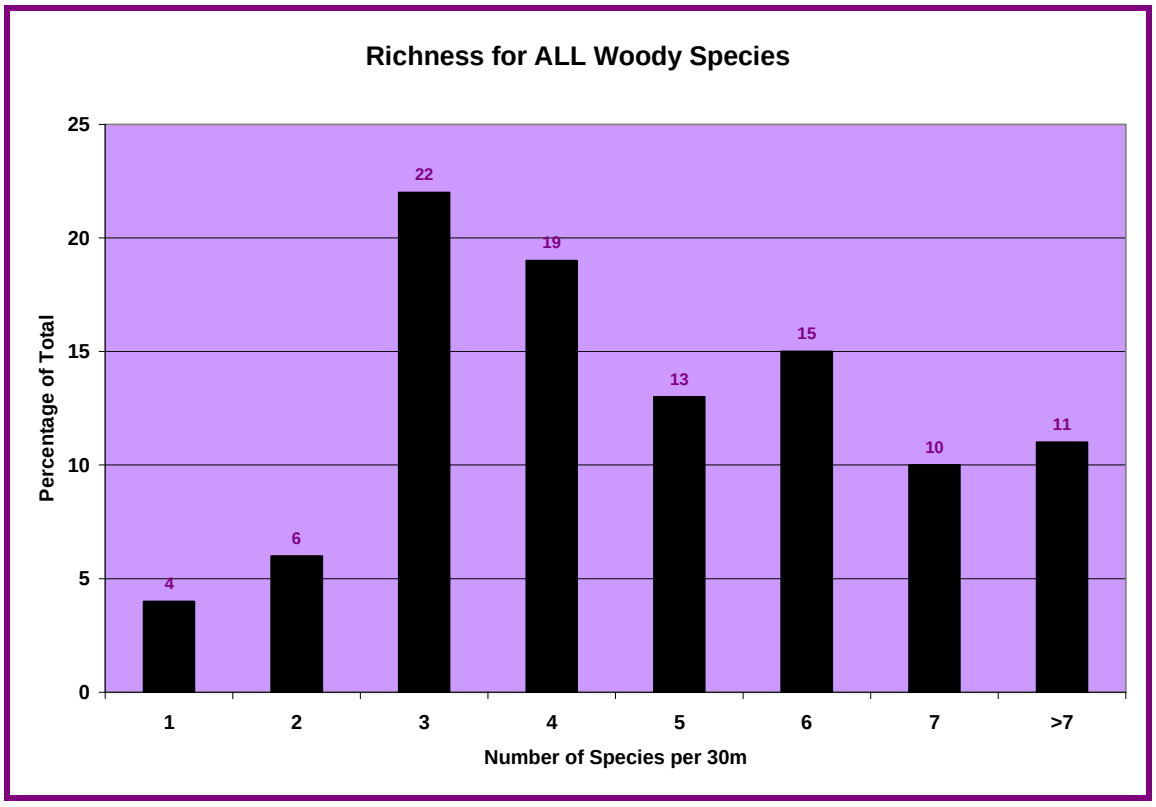


Figure 6.4b. Breakdown of species numbers per hedge for all woody species in Fingal. (excluding *Hedera helix* and *Rubus spp*. and treating climbing *Rosa* as one species).

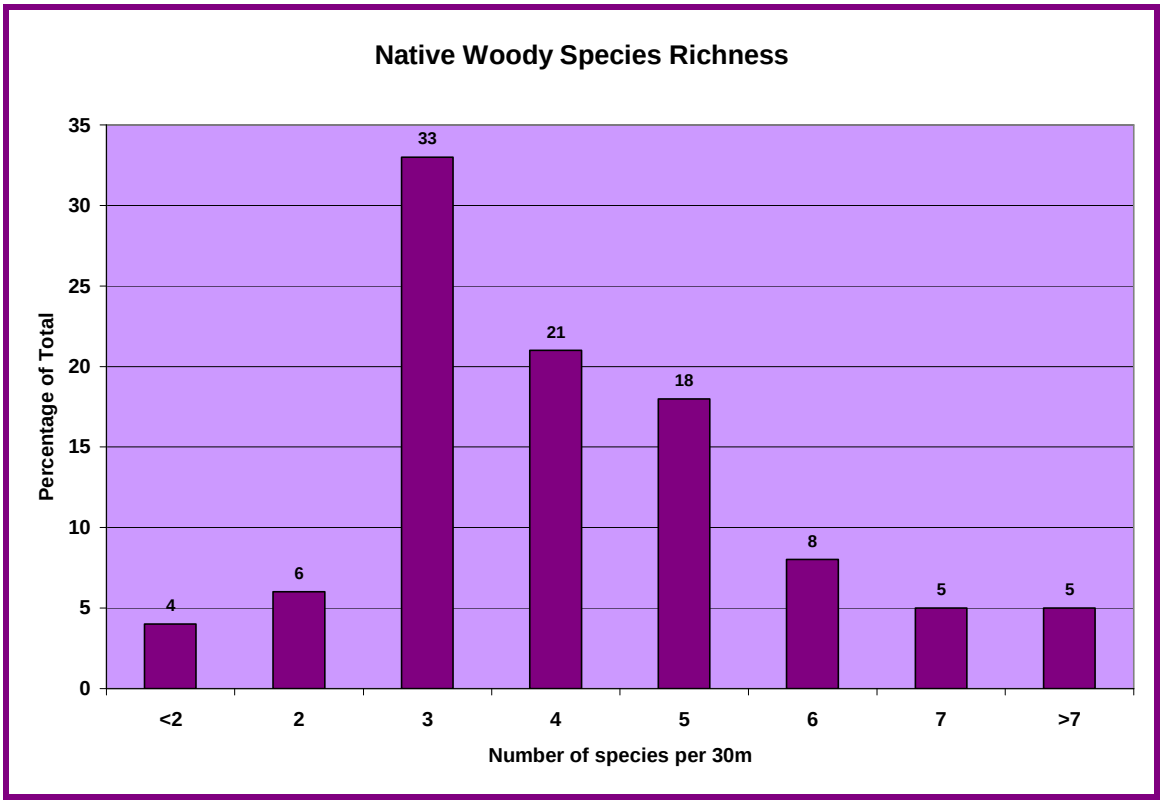


Figure 6.4c. Breakdown of the average species number per hedge for all *native* woody species in Fingal (excluding *Hedera helix* and *Rubus spp*. and treating climbing *Rosa* as one species).

6.4.1 Alien Species in the Woody Flora

Invasive and potentially invasive species pose a large threat to natural and semi-natural plant communities. Invasive species often have a tendency to colonise modified or "disturbed" habitats, such as those found in long-settled areas, and it was thought that because of this tendency, non-native species would make up a large component of hedgerows in Fingal. At 58% occurrence in all the hedges surveyed, non-natives are indeed a significant element of the hedgerow flora. They tended to occur at low frequencies, however, with no hedge having more than 3 non-native species and most having only one non-native species (Figure 6.4.1).

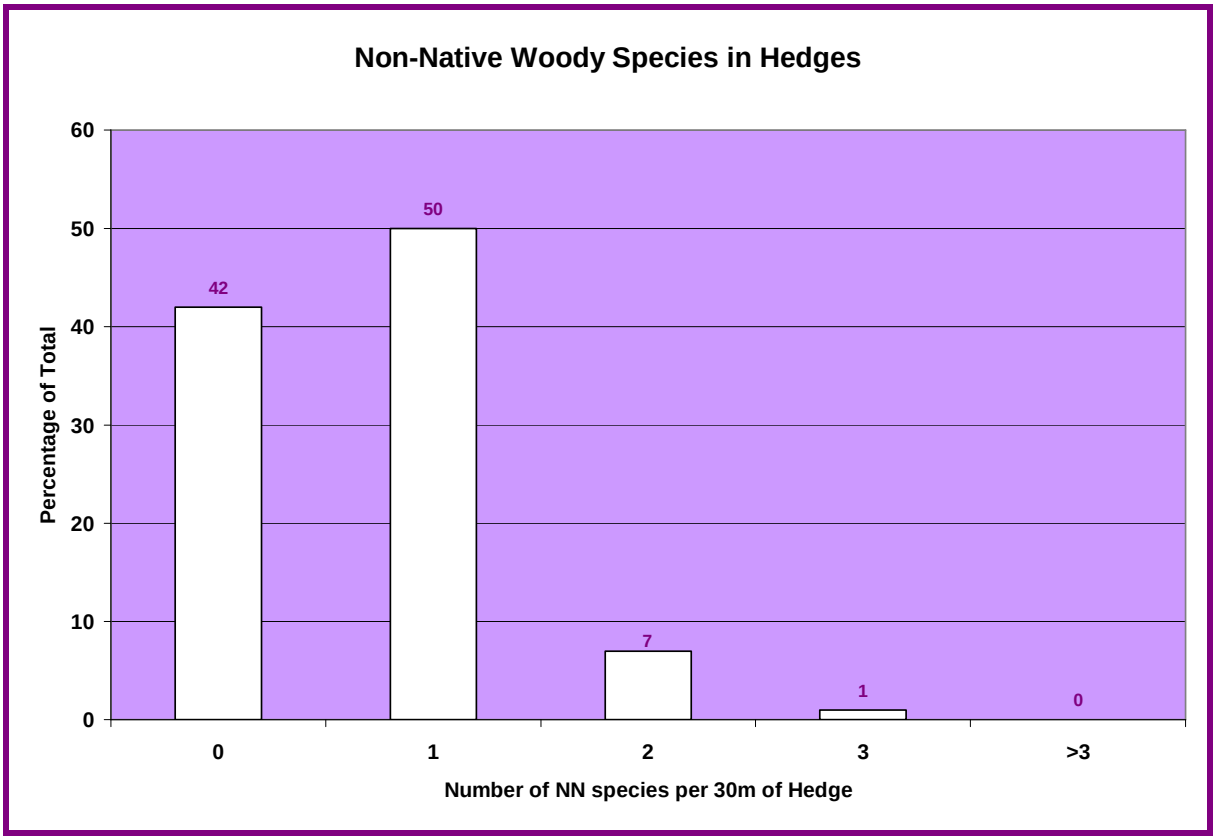
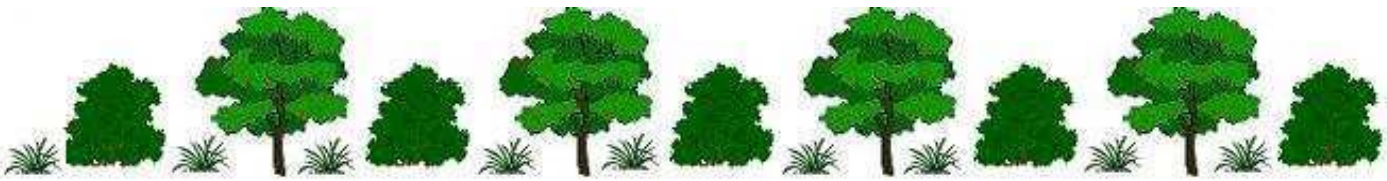


Figure 6.4.1. Percentage breakdown of the number of non-native species per hedge sample.



6.5. Classification of the Woody Plant Community

All hedgerow quadrats were first combined and analysed using the program DECORANA (Hill 1979a) to observe associations between species. A Nearest Neighbor analysis was carried out on the DECORANA results and 3 outlying quadrats (RUS3, CAT1 and CURE4) was removed from further analysis since it was not a characteristic hedge and could potentially skew the final results. CAT 1 is an exceptionally species-rich hedgerow at St. Catherine's Park (14 species), CURE 4 is a species-poor Elm (*Ulmus procera*) and Wild Cherry (*Prunus avium*) hedge at Curragh East, and RUS3 is a nearly pure Elder hedge at a coastal site near Rush Demesne. After the removal of these 3 outliers, classification of the remainder of the quadrats were carried out using the statistical package TWINSPAN (Hill 1979b). The results of classification indicate a very homogeneous data set, with some slight differences in structure, facilitating the division of hedgerow communities into 4 classes based on their woody species composition. The largest class (N=44) produced in the first division (N=79), was that of Ash-Blackthorn hedges, with Holly also being an indicator species, though it occurred at low cover. The second largest class (N=35) was characterised by species-poor Hawthorn hedges. Level 2 produced a further division of these primary groups into communities defined by (1) Hawthorn and Gorse (N=28), (2) Elder and English Elm (*Ulmus procera*) (N=16), (3) Ash (N=21), and (4) Dog Rose and Elder (N=14). Based on these "indicator species" four hedge types can be defined for Fingal as follows:

(1) **Species-poor Hawthorn hedges** (N=35)
These hedges are dominated by Hawthorn, and may contain species such as Bramble, Dog Rose, Wild Cherry, Sycamore, Elder, Ivy and Gorse.

(2) **Blackthorn-Ash-Hawthorn hedges** (N=19)
These hedges are characterised by the presence of Ash, either as a standard or in shrub form, and Blackthorn. Other associated species include Hawthorn, Sycamore, Dog Rose, Gorse, Brambles and Ivy.

(3) **Elm-Elder-Hawthorn hedges** (N=12)
These are hedges of moderate richness, especially if the suckering English Elm does not dominate the hedge. Associated species include Hawthorn, Sycamore, Dog Rose, Wild Cherry, Bramble and Ivy.

(4) **Species-rich hedges with Holly & Hazel** (N=13)
These are the hedges with the highest woody species richness and may have a woodland component to the flora. Holly is frequent, although usually with low cover. A woodland element may exist with the presence of species such as Hazel, Wych Elm, Beech, and Field Rose. Other species that may be present include Blackthorn, Hawthorn, Honeysuckle, Wild Privet, Gorse, Elder, Sally, Dog Rose, Brambles, and Ivy.

6.6. Field Layer

In all, some 138 herbaceous species were recorded in Fingal hedge-bottoms during this survey, but the majority of hedges tend to be characterised by a handful of species that dominate the ground layer. The most frequently occurring species include Ivy (*Hedera helix*), Nettles (*Urtica dioica*), Cleavers (*Galium aparine*), False Oat-grass (*Arrhenatherum elatius*), Couch-grass (*Elytrigia repens*), bent grasses (*Agrostis spp.*), thistles (*Cirsium spp.*), Hogweed (*Heracleum sphondylium*), Cow-parsley (*Anthriscus sylvestris*), docks (*Rumex spp.*) and vetches (*Vicia spp*) Table 6.6). Shadier parts of the hedgebank, including the interior, support shade-tolerant species. If a drain or stream is present beside the hedge, species of permanently wet ground may also be found, including sedges (*Carex spp.*), rushes (*Juncus spp.*), Wild Angelica (*Angelica sylvestris*), Yellow-flag Iris (*Iris pseudoacorus*), willow-herbs (*Epilobium spp.*), Meadowsweet (*Filipendula ulmaria*), Watercress (*Rorippa spp.*) and Water-celery (*Apium nodiflorum*).

Recording the herbaceous flora of a hedge, Curragh East

6.6.1. Herbaceous Species Richness

By far the most common species of the hedge-bottom flora is Ivy (*Hedera helix*) (Table 6.6.1). Nitrophilous species such as Nettles, Cleavers, Hogweed and False Oat-grass and Creeping Thistle were all frequent and often dominated the ground flora.

Common name	*Scientific Name*	Frequency (%)	Common name	*Scientific name*	Cover
Ivy	*Hedera helix*	7.6	Ivy	*Hedera helix*	16.8
Nettles	*Urtica dioica*	5.4	False Oat-grass	*Arrhenatherum elatius*	7.5
Cleavers	*Galium aperine*	5.2	Nettles	*Urtica dioica*	7.5
Hogweed	*Heracleum sphondylium*	4.3	Cleavers	*Galium aperine*	7.1
False Oat-grass	*Arrhenatherum elatius*	3.9	Hogweed	*Elytrigia repens*	5.1
Creeping Thistle	*Cirsium arvense*	3.4	Couch-grass	*Elytrigia repens*	4.8
Bush Vetch	*Vicia sepium*	2.8	Yorkshire Fog	*Holcus lanatus*	3.5
Hart's Tongue fern	*Phyllitis scolopendrium*	2.8	False Brome	*Brachpodium sylvaticum*	2.6
False Brome	*Brachpodium sylvaticum*	2.8	Creeping Thistle	*Cirsium arvense*	2.6
Soft Shield fern	*Polystichum setiferum*	2.7	Creeping Bent	*Agrostis stolonifera*	2.6
Couch-grass	*Elytrigia repens*	2.7	Ryegrass	*Lolium perenne*	2.5
Yorkshire Fog	*Holcus lanatus*	2.6	Cow-parsley	*Anthriscus sylvestris*	2.5
Creeping Bent	*Agrostis stolonifera*	2.5	Soft Shield fern	*Polystichum setiferum*	2.3
Cow-parsley	*Anthriscus sylvestris*	2.4	Creeping buttercup	*Ranunculus repens*	1.9
Creeping buttercup	*Ranunculus repens*	2.3	Sheep's fescue	*Festuca ovina*	1.8
Sheep's fescue	*Festuca ovina*	2.2	Bush Vetch	*Vicea sepium*	1.7
Ryegrass	*Lolium perenne*	2.1	Meadowsweet	*Filipendula ulmaria*	1.6
Germander Speedwell	*Veronica chamaedrys*	2.1	Bittersweet Nightshade	*Solanum dulcamara*	1.5
Cock's-foot	*Dactylis glomerata*	1.9	Hart's Tongue fern	*Phyllitis scolopendrium*	1.5
Dandelion	*Taraxacum officinale agg.*	1.7	Bent-grass	*Agrostis capillaris*	1.5
Bittersweet	*Solanum dulcamara*	1.6	Cock's-foot	*Dactylis glomerata*	1.2
Meadowsweet	*Filipendula ulmaria*	1.6	Germander Speedwell	*Veronica chamaedrys*	1.0
Wood avens	*Geum urbanum*	1.5	Dandelion	*Taraxacum officinale agg.*	0.84
Herb-robert	*Geranium robertianum*	1.5	Hairy Brome	*Bromopsis ramosa*	0.79
Wood Dock	*Rumex sanguineus*	1.3	Hoary Willow-herb	*Epilobium hirsutum*	0.78
Bent-grass	*Agrostis capillaris*	1.3	Wood avens	*Geum urbanum*	0.75

Table 6.6. Frequency and cover of some of the more common species of Fingal hedge bottoms. (The species that are most prominent in both cover and occurrence are highlighted.)

6.6.2. Diversity of the Hedge-bottom Flora

To compare species richness and evenness of the herbaceous flora between all 82 sampled hedgerows, a diversity index was calculated using data from each of the three quadrats taken within each hedgerow. The index used was a version of the Simpson's Diversity Index,

$$D = -\ln \sum p_i^2,$$

where D is the index of diversity, and $-\ln \sum p_i^2$ is the negative natural logarithm of the sum of each square of the proportional cover of individual species within a sample (Pielou 1975). The definition of p_i in this case is the proportion of the total cover of a particular species (n) over the total cover for all recorded species (N) within each quadrat. A high D value (and low p_i), therefore, is indicative of high diversity. The values for sites with the ten highest and ten lowest are given in Table 6.6.2a.

Highest Diversity		Lowest Diversity	
Location/Quadrat#	**Diversity Index for Herbaceous Species**	**Location/Quadrat #**	**Diversity Index for Herbaceous Species**
St. MARGARET'S 1A	**3.01**	**CHARSTOWN 5C**	0
NEWPARK 4A	2.41	**CURRAGH WEST 3B**	0
St. CATHERINE'S 1B	2.35	**DOLLARDS 1C**	0
PLUCKHIMIN 2A	2.23	**HOWTH 2B**	0
DOLLARDS 3A	2.21	**HOWTH 3C**	0
CHARSTOWN 5A	2.18	**RUSH 2B**	0.08
PLUCKHIMIN 3A	2.18	**HILLTOWN 3C**	0.10
WIMBLETOWN 2A	2.18	**WIMBLETOWN 4C**	0.10
CAUSESTOWN 3A	2.13	**St. MARGARET'S 2B**	0.10
WYANSTOWN 5A	2.10	**CAUSESTOWN 4A**	0.11
WYANSTOWN 4B	2.07	**HOWTH 1C**	0.12
WYANSTOWN 2A	2.04	**RUSH 3C**	0.12
WYANSTOWN 5B	2.04	**DOLLARDS 2C**	0.15
HILLTOWN 3A	2.03	**HOWTH 2C**	0.17
DOLLARDS 4A	2.03	**NEWPARK 3C**	0.18
CURRAGH EAST 3A	2.02	**HOLLYTOWN 1C**	0.18
PLUCKHIMIN 5B	2.00	**HILLTOWN 5C**	0.19
CURRAGH WEST 2A	2.00	**DOLLARDS 3C**	0.20
HOWTH 1A	2.00	**WYANSTOWN 1C**	0.22
PLUCKHIMIN 4B	1.99	**CURRAGH WEST 2C**	0.22
CHARSTOWN 1B	1.98	**HILLTOWN 4C**	0.23
NEWBRIDGE 3B	1.98	**GORMANSTOWN 1C**	0.25
DOLLARDS 3B	1.98	**CHARSTOWN 5B**	0.25

Table 6.6.2a. Hedgerow quadrats with the highest and lowest herbaceous species diversity.

Note that the majority of quadrats with low diversity are those from the hedge interior, each of which is labeled "C". Where marginal quadrats (A and B) have low diversity, the hedge margin has either been removed, treated with herbicide, overgrazed, or reduced to bare ground. Only occasionally is the low diversity the result of domination of the field layer by a single species, usually Ivy or occasionally, in tillage areas, Barren Brome (*Bromus sterilis*).

Species diversity often correlates with richness, however a site with high species richness will not necessarily have high species diversity if the cover values for each species is low. The Simpson's Diversity Index, therefore, is indicative not only richness, but also evenness, or the distribution of each species throughout a sample. The diversity of each of the herbaceous quadrats in this survey is plotted against the species richness of the same quadrats in Figure 6.6.2. It can be seen from the graph that some of the sites with the highest numbers of herb species do not necessarily have the highest diversity.

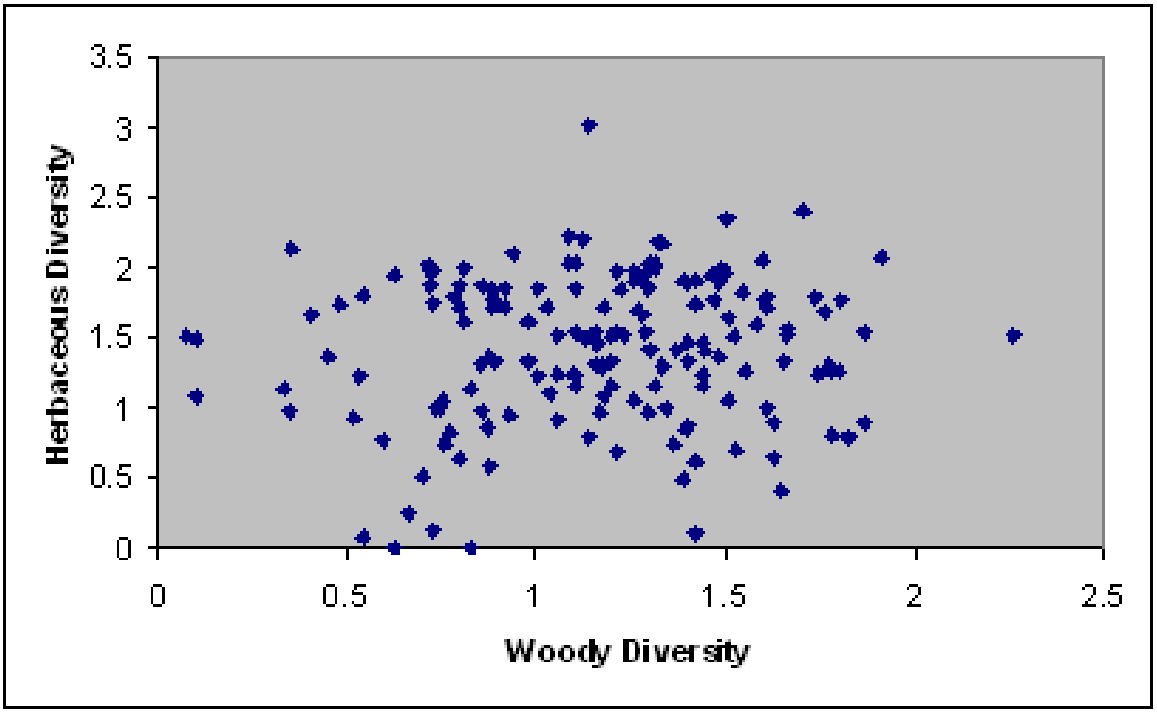


Figure 6.6.2. Graph of herb species diversity in Fingal hedge-bottom quadrats against the woody species diversity.

When compared with the woody flora, it becomes obvious that there is only a weak link between the diversity of the herbaceous flora and the richness of the woody overstory (Table 6.6.2a), suggesting that other factors may be affecting the hedge-bottom flora. Only 2 of the fifteen quadrats with highest woody species diversity also had the highest herbaceous species diversity in at least one of the three quadrats taken from the 30m hedge sample (St. Catherine's 1 & Wyanstown 4). Likewise, only two of the fifteen with the lowest woody species diversity also had the lowest herb diversity in at least one quadrat (Rush 2 & 3). Possibilities for this discrepancy are discussed later.

Highest Woody Species Diversity (excluding Bramble & Ivy and including alien species)		Highest Herb Diversity	
Location/Hedge #	**Diversity Index for Woody Species**	**Location/Hedge #**	**Diversity Index for Herbaceous Species**
HOLLYTOWN 3B	**2.26**	**ST. MARGARET'S 1A**	**3.01**
WYANSTOWN 4B	1.91	**NEWPARK 4A**	2.41
GORMANSTOWN 3B	1.87	**ST. CATHERINE'S 1B**	2.35
HOLLYTOWN 3A	1.87	**PLUCKHIMIN 2A**	2.23
GORMANSTOWN 1A	1.82	**DOLLARDS 3A**	2.21
GORMANSTOWN 3A	1.81	**CHARSTOWN 5A**	2.18
WYANSTOWN 4A	1.80	**PLUCKHIMIN 3A**	2.18
ARDGILLAN 4B	1.78	**WIMBLETOWN 2A**	2.18
HILLTOWN 5B	1.78	**CAUSESTOWN 3A**	2.13
NEWPARK 4B	1.77	**WYANSTOWN 5A**	2.10
CURRAGH EAST 2B	1.77	**WYANSTOWN 4B**	2.07
St. CATHERINE'S 1A	1.76	**WYANSTOWN 2A**	2.04
HILLTOWN 5A	1.74	**WYANSTOWN 5B**	2.04
GORMANSTOWN 1B	1.74	**HILLTOWN 3A**	2.03
NEWPARK 4A	1.70	**DOLLARDS 4A**	2.03
Lowest Woody Species Diversity (excluding Bramble & Ivy and including alien species)		**Lowest Herb Diversity**	
Location/Hedge #	**Diversity Index for Woody Species**	**Location/Quadrat #**	**Diversity Index for Herbaceous Species**
CURRAGH EAST 1A	0.08	**CHARSTOWN 5C**	0
RUSH 3A	0.10	**CURRAGH WEST 3B**	0
RUSH 3B	0.10	**DOLLARDS 1C**	0
St. MARGARET'S 4B	0.33	**HOWTH 2B**	0
HOLLYTOWN 2A	0.35	**HOWTH 3C**	0
CAUSESTOWN 3A	0.36	**RUSH 2B**	0.08
HOLLYTOWN 2B	0.41	**HILLTOWN 3C**	0.10
NEWBRIDGE 4B	0.45	**WIMBLETOWN 4C**	0.10
CAUSESTOWN 3B	0.48	**St. MARGARET'S 2B**	0.10
ARDGILLAN 2B	0.52	**CAUSESTOWN 4A**	0.11
CURRAGH WEST 4A	0.53	**HOWTH 1C**	0.12
CURRAGH WEST 4A	0.53	**RUSH 3C**	0.12
RUSH 2A	0.54	**DOLLARDS 2C**	0.15
RUSH 2B	0.54	**HOWTH 2C**	0.17
RUSH 1B	0.60	**NEWPARK 3C**	0.18

Table 6.6.2b. Combined tables comparing quadrats with highest and lowest herb species diversity with quadrats with highest and lowest woody species diversity. Shared quadrats are highlighted.

6.6.3. Woodland Herbs in the Hedge-bottom

Shade-tolerant, herbaceous species found in Fingal hedgerows include False Brome (*Brachypodium sylvaticum*) and ferns, mainly two common species, the Soft Shield Fern (*Polystichum setiferum*) and Hart's Tongue Fern (*Phyllitis scolopendrium*) which, in conjunction with Ivy (*Hedera helix*) and the occasional Polypody Fern (*Polypodium vulgare* agg.), are often the only species found in the dark interior of the hedge. Less common woodland elements that were found occasionally in the hedge-bank include Male-ferns (*Dryopteris* spp.), Wood Melick (*Melica uniflora*), Wood sedge (*Carex sylvatica*), Cuckoo-Pint (*Arum maculatum*), Sweet Woodruff (*Galium odoratum*), Herb-robert (*Geranium robertianum*), Ground Ivy (*Glechoma hederacea*), Tutsan (*Hypericum androsaemum*), Primrose (*Primula vulgaris*), Sanicle (*Sanicula europaeus*) and Dog-Violets (*Viola riviniana, V. reichenbachiana*).

Due to deep shade, the centre of the three herbaceous quadrats (labeled as C, Figure 3.2) taken in each hedgerow sample was often the poorest in species diversity and richness. The ferns however, have a strong affinity for this part of the hedge, being more rarely encountered in the marginal quadrats and not at all in the adjacent open landscape (Table 6.6.2b). Fern density and abundance was also enhanced by the presence of a drain or stream.

Species	Side A	% occur.	Centre (C)	% occur.	Side B	% occur.	Total No. occurrences	Total No. Quadrats	Frequency
Polystichum setiferum	9	**15%**	**48**	**80%**	3	**5%**	**60**	**246**	**24%**
Phyllitis scolopendrium	3	**6%**	**47**	**87%**	4	**7%**	**54**	**246**	**22%**
Polypodium vulgare agg.	**0**	**0%**	**6**	**100%**	**0**	**0%**	**6**	**246**	**2%**

Table 6.6.3. Distribution and frequency of some common woodland fern species in Fingal hedges.

Some woodland elements of the hedge-bottom flora of Fingal.

6.7. Townland Boundary and Roadside Hedges

Doogue & Kelly (2006) indicated that, for Leinster in general, roadside hedges are more species-rich than other hedges. In this survey, roadside hedges are compared with non-roadside hedges (inter-field hedges). The richness of woody species is compared between the two, and excludes Bramble (*Rubus fruticosa* agg.) and Ivy (*Hedera helix*) while treating all *Rosa canina* subspecies and hybrids as one. The average woody species richness was actually highest for inter-field hedges that coincide with old townland boundaries, with an average of 4.7 native species per 30 metre sample and 5.8 overall average (including non-natives) (Figure 6.7 and Table 6.7) Those inter-field hedges that did not coincide with townland boundaries were found to have the lowest woody species richness (3.8 native, 4.3 overall). Although roadside hedges did not have the highest mean woody species richness, they did however, have the highest herbaceous species richness, especially where they overlap townland boundaries. Inter-field hedges that coincide with townland boundaries also had high herb species richness, while non-townland boundaries had the lowest.

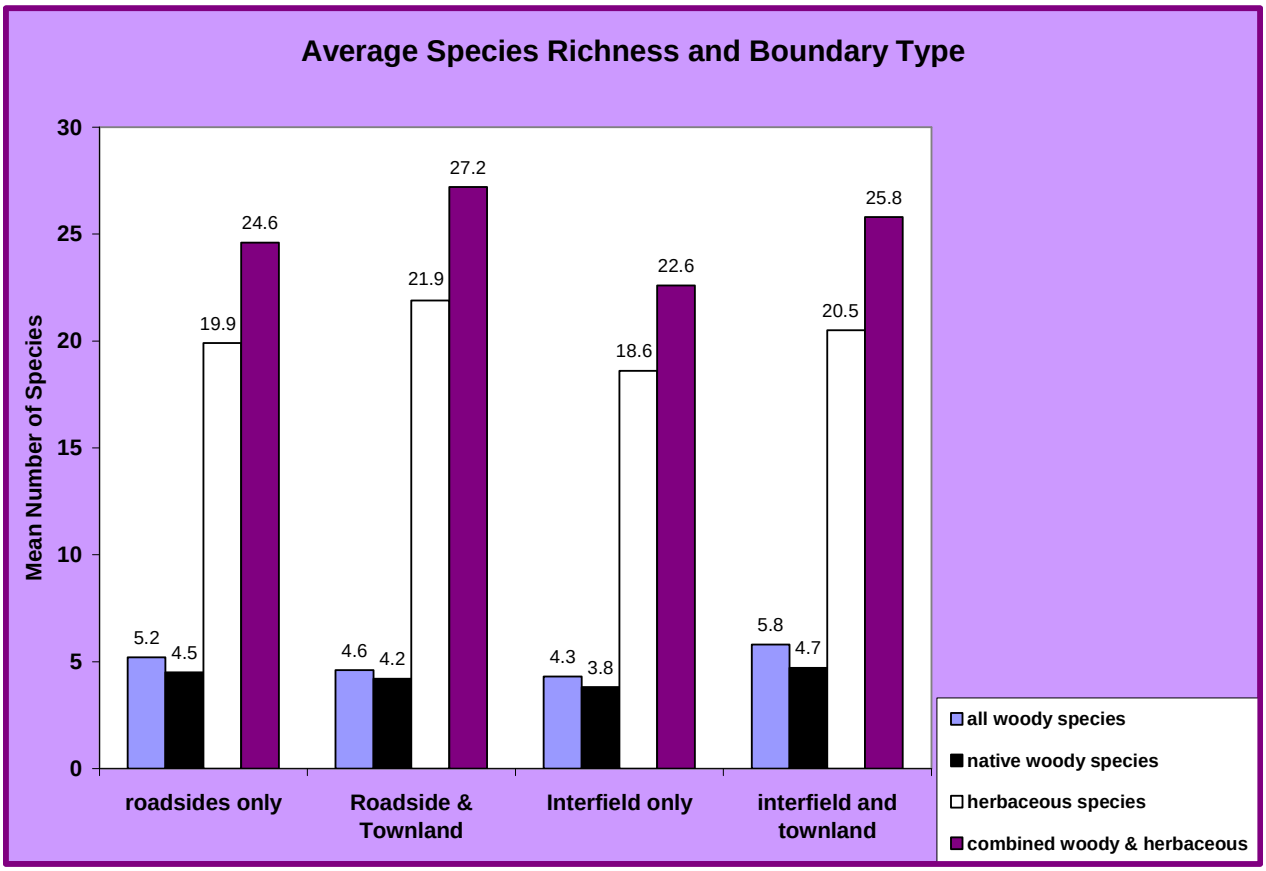


Figure 6.7. The mean species richness of various boundary types in Fingal.

Hedge Location *Boundary type*	**Roadside Hedges**		**Inter-Field Hedges**	
	Townland Boundary	***Non-Townland Boundary***	***Townland Boundary***	***Non-Townland Boundary***
Number of hedges	14	18	20	28
Mean Woody Species Richness (*Native spp. only*)	4.2 (0.52 st. error)	4.5 (0.35 st. error)	4.9 (0.49 st. error)	3.8 (0.36 st. error)
Overall Mean Woody Species Richness (*Including Exotics*)	4.6 (0.59 st. error)	5.2 (0.42 st. error)	5.8 (0.70 st. error)	4.3 (0.43 st. error)
Mean Herbaceous Species Richness	21.9 (1.86 st. error)	19.9 (1.60 st. error)	20.5 (1.12 st. error)	18.6 (1.12 st. error)
Average Combined Species Richness (woody + herbaceous)	27.2 (2.28 st. error)	24.6 (1.66 st. error)	25.8 (1.50 st. error)	22.6 (1.35 st. error)

Table 6.7. Average species richness of roadside vs. inter-field hedges

Species-rich ash-hazel hedge along a townland boundary dividing wheat fields near Newpark, southwestern Fingal.

Roadside hedge near Dollards, central Fingal.
The drain and adjacent bank support abundant Epilobium hirsutum, Eupatorium cannabinum, Equisetum telmateia and Filipendula ulmaria, species normally associated with wetlands.

7.0. Factors influencing Species Composition & Richness of Fingal Hedgerows

7.1. Links With Other Habitats

The linear network of hedgerows has often been suggested to function as a natural "corridor" to facilitate the diffusion of plant and animal populations across a cultural landscape (Tew 1994, Pollard 1973). This may be especially true for woodland species that continue to persist in the sparsely wooded landscape of Fingal. By the same token, the linear "connectivity" of hedgerows may also potentially smooth the way for invasive exotics to spread out across the landscape. The majority of hedgerows in this survey (57%) were linked only to another hedge or treeline, while 36% were connected to natural and semi-natural habitats such as water features, woodland, scrub, bog and semi-natural grassland (Figure 7.1). Six percent were connected to gardens and forestry plantations, which are potential sources of exotic and invasive plant species.

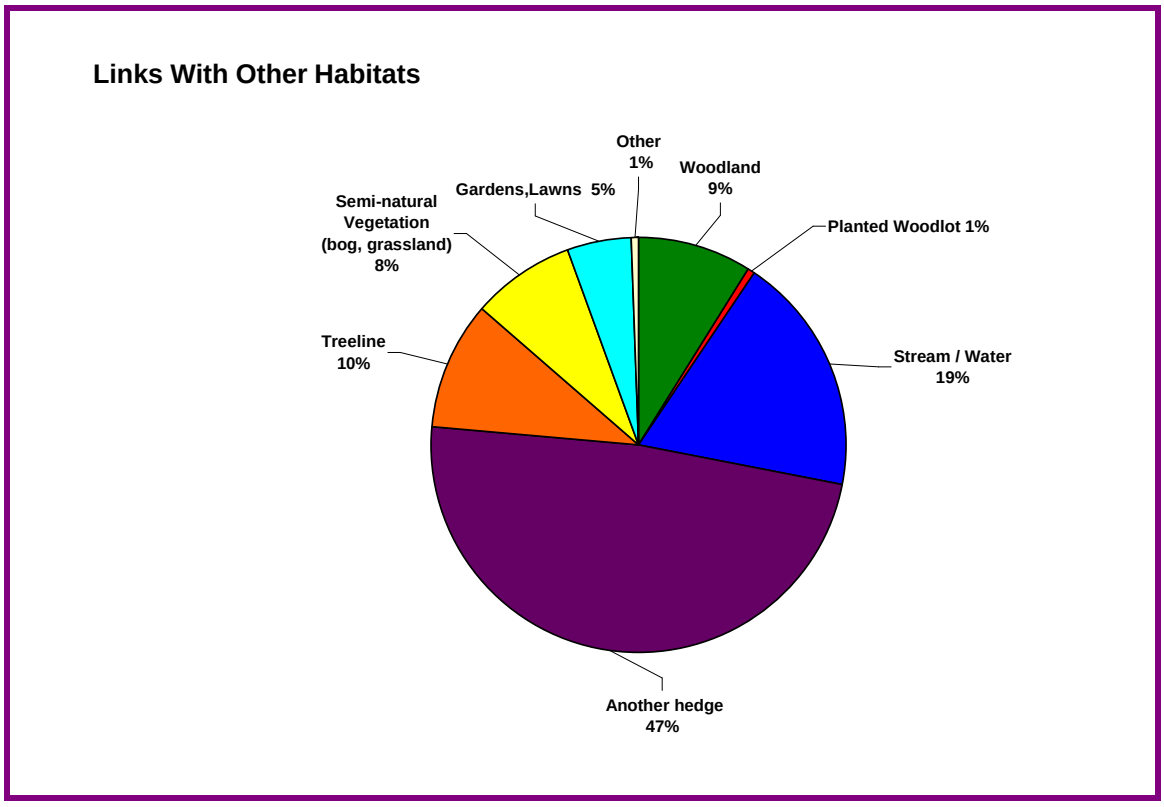


Figure 7.1. Links with other habitats for the surveyed 30m hedgerow quadrats

7.2. Hedge Width

In this survey, the mean width of the sampled hedgerows was 5.7 metres, with most hedges falling between 3.5 and 5 metres in width. Nearly 18% of those surveyed were over 7 metres in width (Figure 7.2.) and the maximum width was 16 metres for one hedge on the golf course near Howth summit (HWT2). The minimum width was 2.5 metres for a roadside hedge at Curragh East (CURE5), and none of those surveyed were less than 2 metres wide. The presence of so many wide hedges in Fingal compared to other Irish counties (Foulkes & Murray, a,b,c,d) is notable. One possible reason for this is the general lack of hedgerow management in the region (section 9.0. of this report).

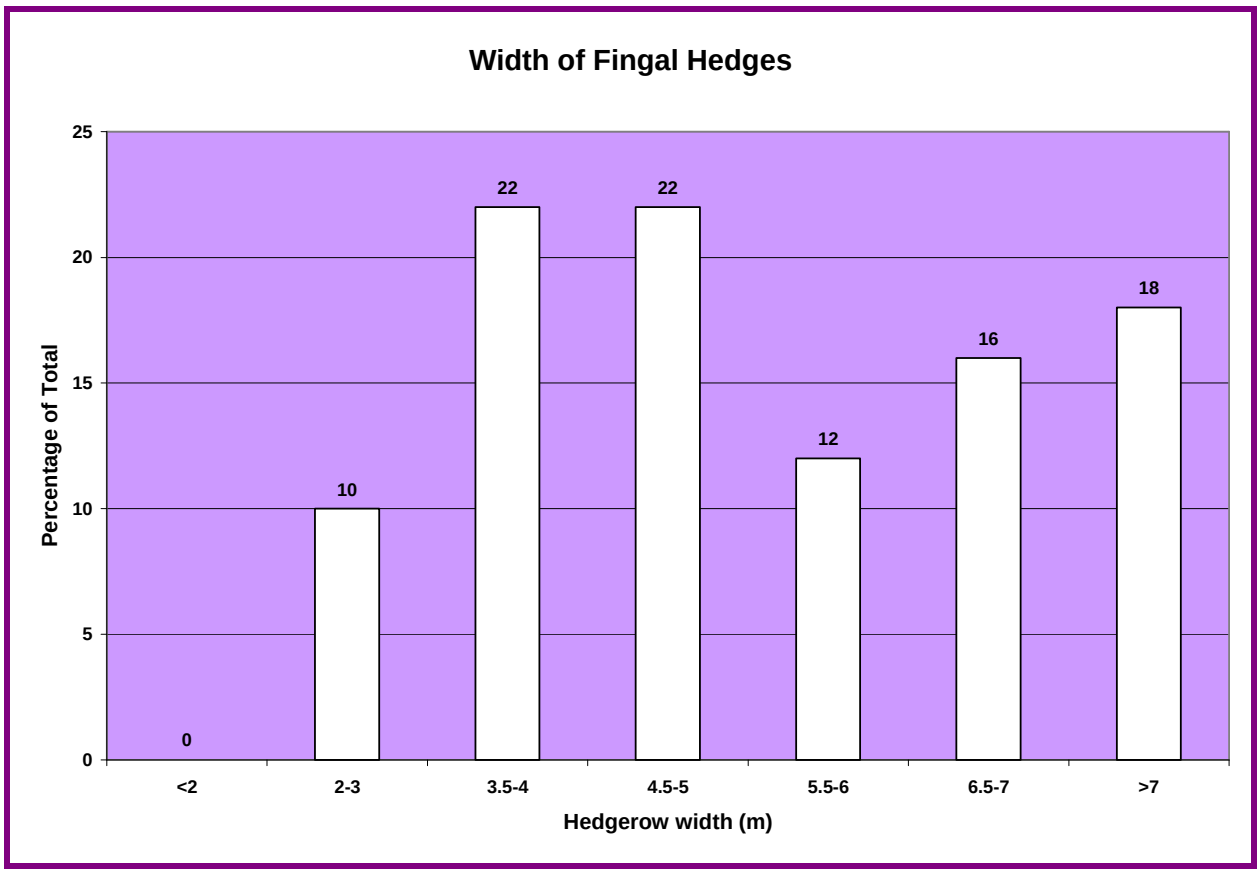


Figure 7.2. Breakdown of hedgerows by width.

7.3. Hedgerow Width and Species Richness

Previous studies in Britain, Northern Ireland and North America (Cummins & French 1992, Boatman et al. 1992, Hegarty & Cooper, 1994, Forman & Baudry 1984) have suggested that wide hedges and those with wide verges tend to support more species than narrow hedges. This makes wide hedges important reserves of biodiversity and more likely to fulfill the role of corridors for the dispersal of species. In this survey, there did not appear to be a significant relationship between hedgerow width and the average number of woody and herbaceous species supported by the hedge (Figure 7.3). It appeared, however, that hedges between 8.5 and 10 metres in width supported slightly higher numbers of woody species, while those between 4.5 and 6 metres in width had slightly more herbaceous species. All hedges over 10 metres in width had fewer species overall, suggesting that extremely wide hedges have reduced biodiversity, possibly due to shading.
In parts of Ireland, Foulkes & Murray have found that hedges less than 2 metres wide supported fewer woody species than wider hedges (2005 a,b,c,d) but no hedges less than two metres in width were found in this survey.

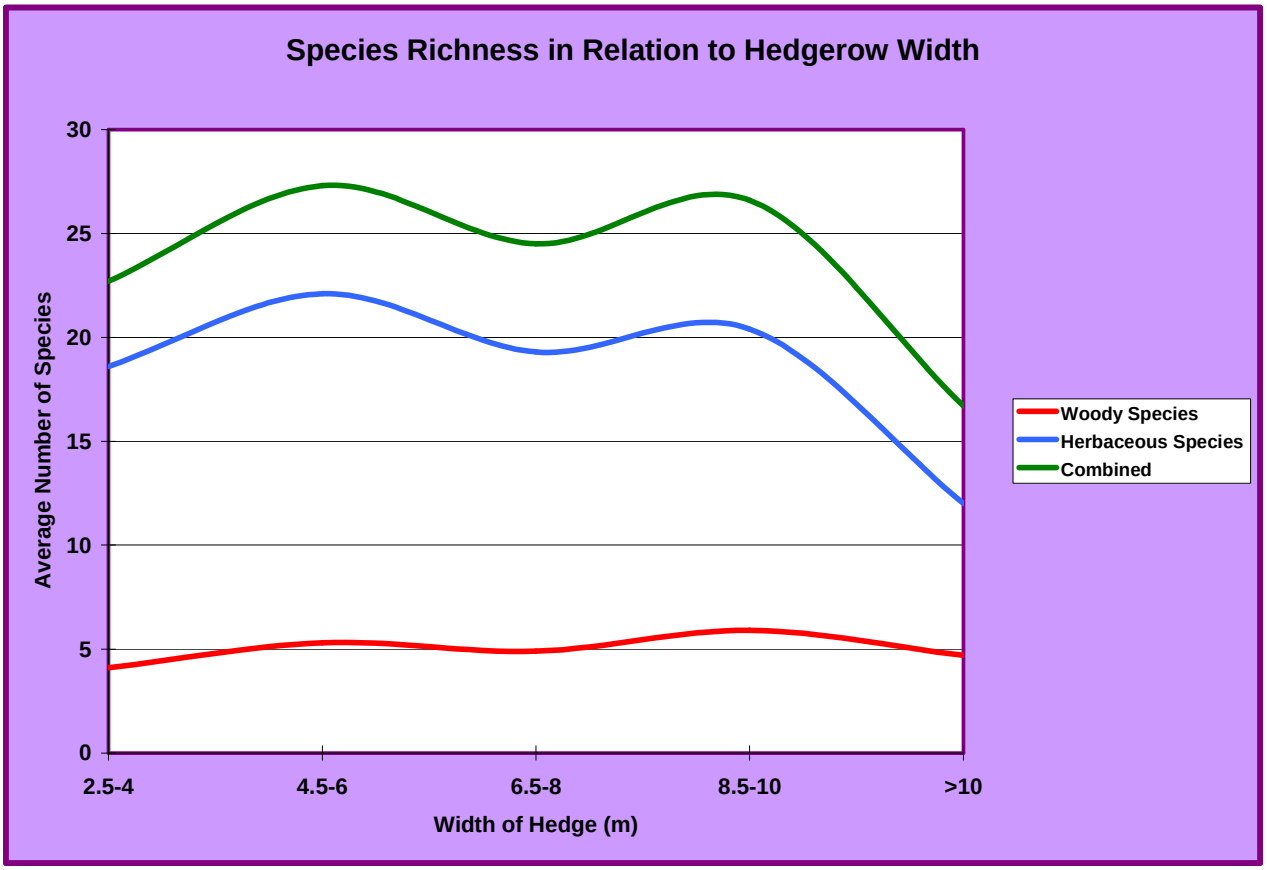


Figure 7.3. Graph illustrating the species richness for each width class of hedgerows in Fingal.

Extremely wide hedges may be prime candidates for colonization by herbaceous woodland species since wide hedges are more likely to mimic woodland conditions of shading, humidity and reduced disturbance. Of the potential woodland herbs found in this survey, all tended to be found in hedgerows that were wider than the overall hedgerow average of 5.6 metres (Table 7.3.). Only Hart's Tongue Fern (*Phyllitis scolopendrium*), Wood Sedge (*Carex sylvatica*), Polypody Fern (*Polypodium vulgare*) and Soft Shield Fern (*Polystichum setiferum*) did not appear to be affected by hedgerow width, since they occurred in all the hedgerow sizes surveyed.

Woodland Herb Species	**Common Name**	**Average width of Hedges**
Arum maculatum	Lords-and-Ladies, Cuckoo-Pint	7.14
Dryopteris dilitata	Broad Buckler Fern	7
Dryopteris filis-maas	Buckler Fern	7
Primula vulgaris	Primrose	6.8
Viola riviniana/reichenbachiana	Dog Violets	6.28
Glechoma hederae	Ground Ivy	6.25
Brachypodium sylvaticum	False Brome	6.21
Galium odoratum	Sweet Woodruff	6
Melica uniflora	Wood Melick	6
Phyllitis scolopendrium	Hart's Tongue Fern	5.94
Carex sylvatica	Wood Sedge	5.88
Polystichum setiferum	Soft Shield Fern	5.72
Polypodium vulgare	Polypody Fern	5.3
	Average Width of all surveyed hedges	**5.6**

Table 7.3. Average widths of hedges in which some potential woodland species are found in Fingal.

7.4 Hedge Height

The average estimated height of hedgerows in Fingal is 4.3, with the tallest sampled hedges recorded at 10 metres in height (ARD4, HWT1, NBRD5), and the shortest, only 1.5 metres in height (GORM5, CAUS5). In comparing bird species richness and field boundary characteristics, many researchers have discovered that bird species numbers and nesting are directly related to hedgerow height, with hedges over 4 m in height supporting the greatest numbers (Moles & Breen 1995, Parish et al. 1992, Arnold, 1983). While different bird species have different requirements, tall hedges are more' likely to support more bird species than shorter ones, therefore tall hedges should be taken into consideration in schemes aimed at increasing bird diversity on farms. Just over half (52%) of Fingal hedges were 4 metres or less in height (Figure 7.4).

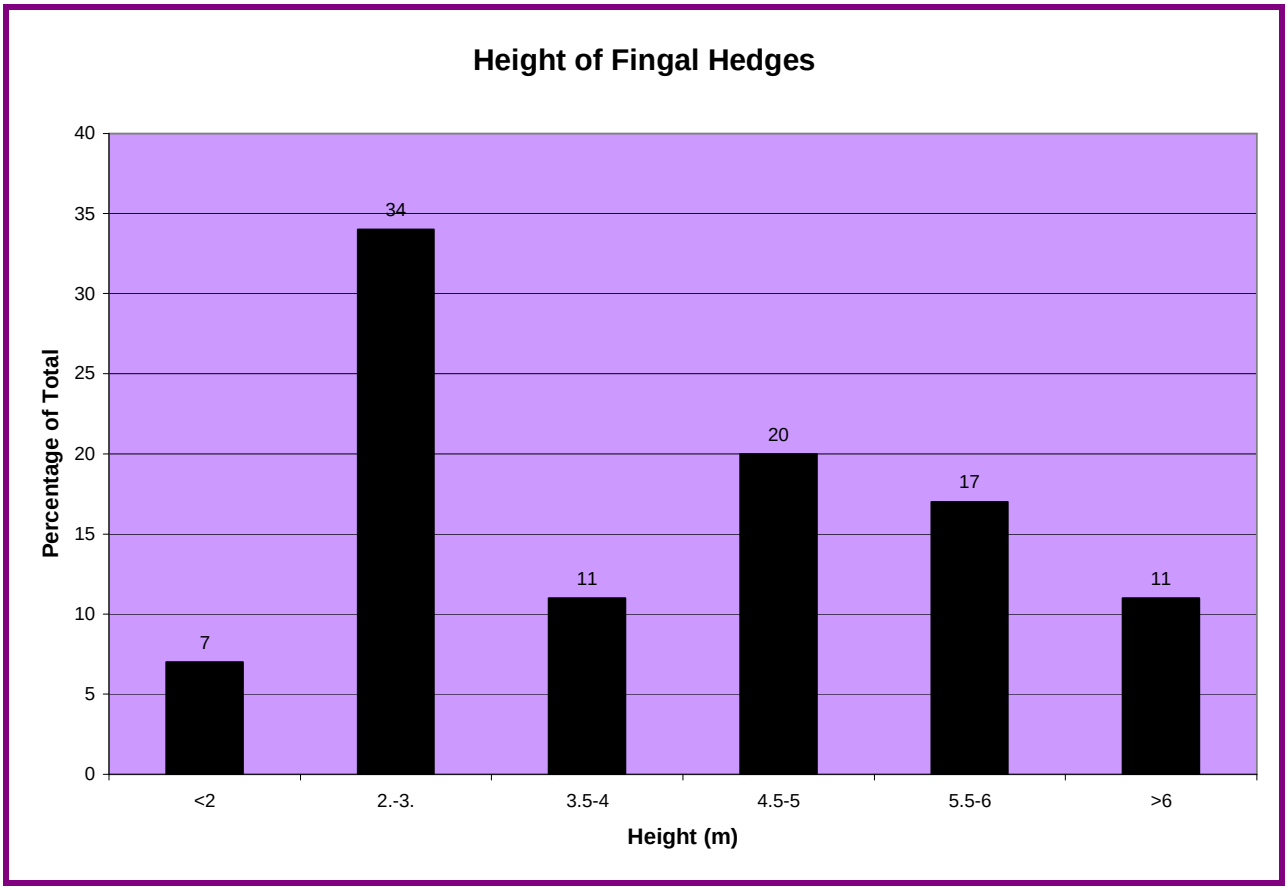


Figure 7.4. Breakdown of hedgerow height in Fingal.

7.5 Associated features

7.5.1. Banks

Ninety-nine percent of hedges in Fingal have a bank associated with the hedgerow, with nearly half of these (47%) being over a half metre in height (Figure 7.5.1). It was observed that hedge-banks tended to be in poor and degraded condition in stock-rearing areas, particularly if sheep or cattle are the stock of choice. Where not fenced away from the hedgerow (Plate 7.5.1a), cattle were observed to graze and trample hedge-banks, causing severe erosion, while heavy grazing by large stocking numbers of sheep also led to overgrazing and erosion, particularly if the hedge was no longer being managed as a boundary (Plate 7.5.1b). Those hedge-banks in tillage areas were observed to be intact if located within the hedge proper, but often damaged or removed if close to the field margin (Plate 7.5.1c). Hedges in tillage areas often had very little margin, this having been removed during cultivation and expansion of the adjoining field.

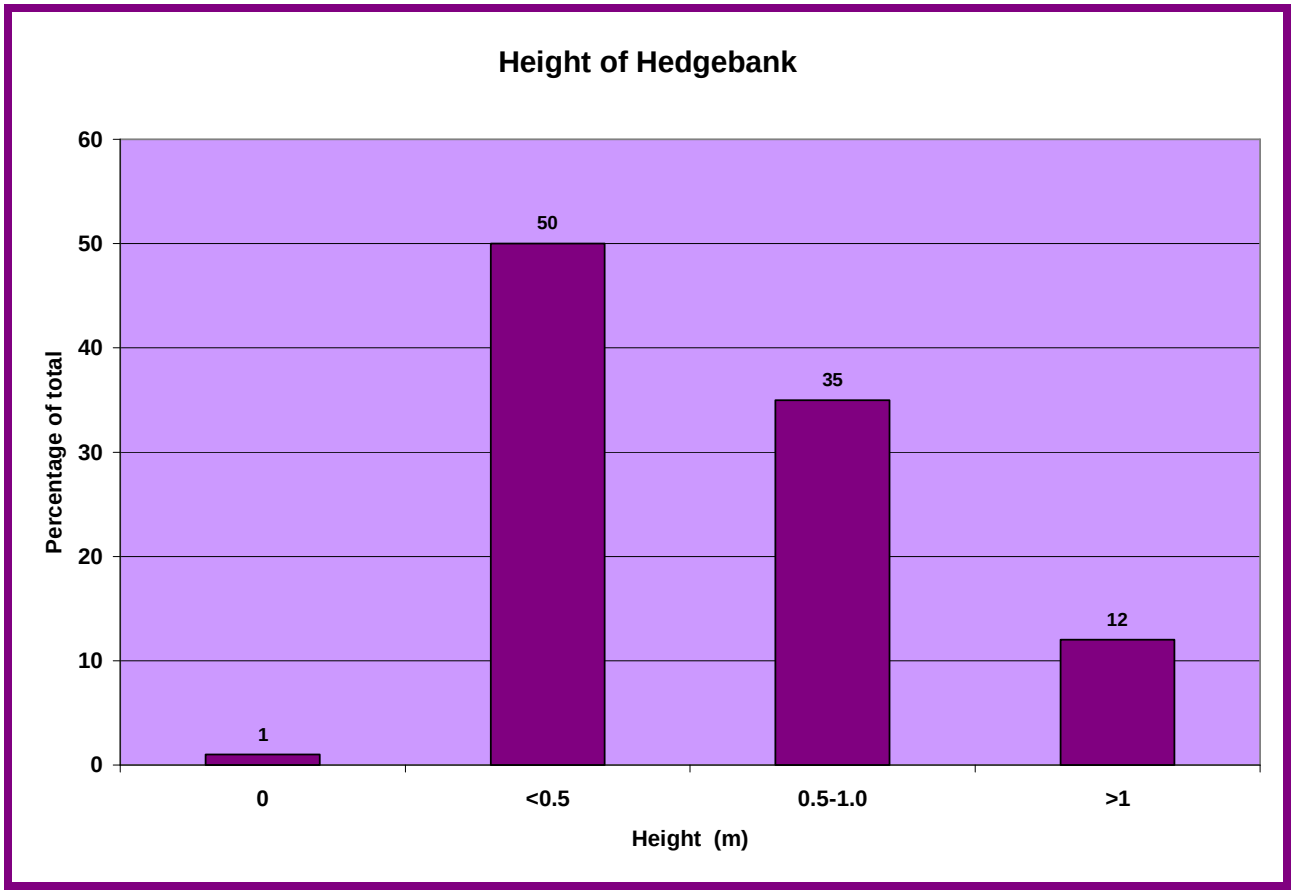


Figure 7.5.1. Height of hedge-banks associated with hedgerows in Fingal.

Hedgebanks are often home to a wide variety of animals, including badger, fox, hedgehog, hare and many other small mammals. Their dens were often observed in Fingal hedgebanks.

Plate 7.5.1a. A relatively well-maintained hedge that is reinforced by post and wire fencing well away from the hedgerow, creating a small margin that enables the survival of a hedge-bottom flora out of reach of hungry cows (**a)**!

Plate 7.5.1b. A severely grazed hedge-bottom in which the hedgerow has lost all function as an active boundary (note wire fencing) **(b)** and a tall hedge that has lost its margin and part of a bank due to expansion of the adjacent wheat field **(c)**.

7.5.2. Walls

None of the hedgerows surveyed contained walls or any other features made of stone. This may be due to the scarcity of stone as a building material in Fingal, unlike the west of Ireland, where the abundance of stone has facilitated the construction of walls as field boundaries.

7.5.3. Drains

The presence of a large drain or stream often adds a wetland dimension to the hedge-bottom flora, with the addition of species of permanently wet ground, particularly if bounded on only one side by woody vegetation. Drains are also beneficial to wildlife as a supply of water, and deep drains may benefit the flora of the hedge interior as a buffer from external factors such as drying as well as grazing and trampling. 43% of the surveyed hedges had ditches over 1 metre in depth while only 10% had no drain at all (Figure 7.5.3). In some areas of Fingal, the drains facing roadsides had been filled in, effectively eliminating the hedge-margin and its associated flora.

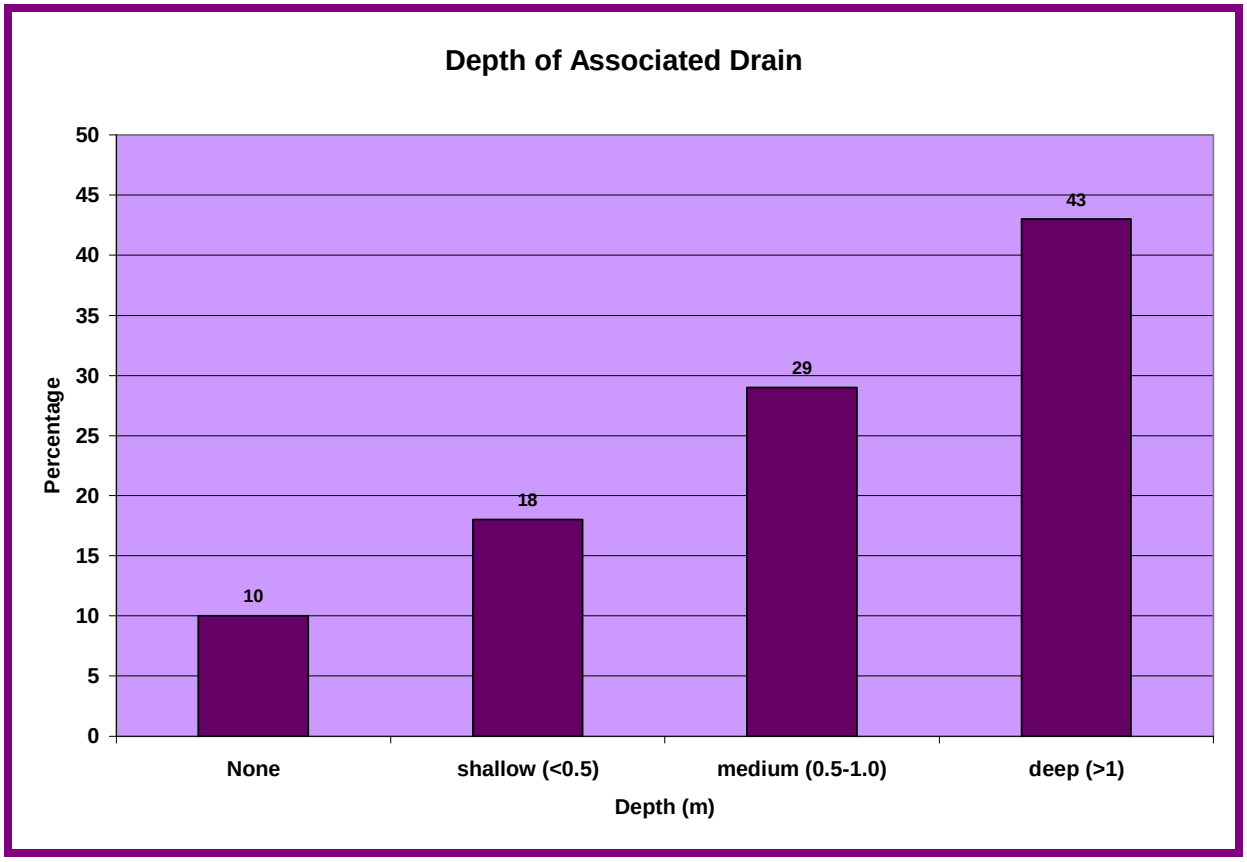


Figure. 7.5.3. Depth of drains associated with hedgerows in Fingal.

7.5.4 Fencing

Thirty-nine percent of the sampled hedgerows were reinforced by additional fencing (Figure 7.5.4). This may be due to the declining functionality of hedgerows as stock-proof barriers in Fingal. In 16% of the cases, barbed wire fencing was directly attached to the stems of hedgerow shrubs and trees. This practice should be discouraged, as it wounds the stems and may make them more vulnerable to disease and structural weaknesses, which can be especially dangerous in the case of large trees. The presence of wire fencing in the hedgerow is also potentially dangerous to operators of hedge-cutting machinery.

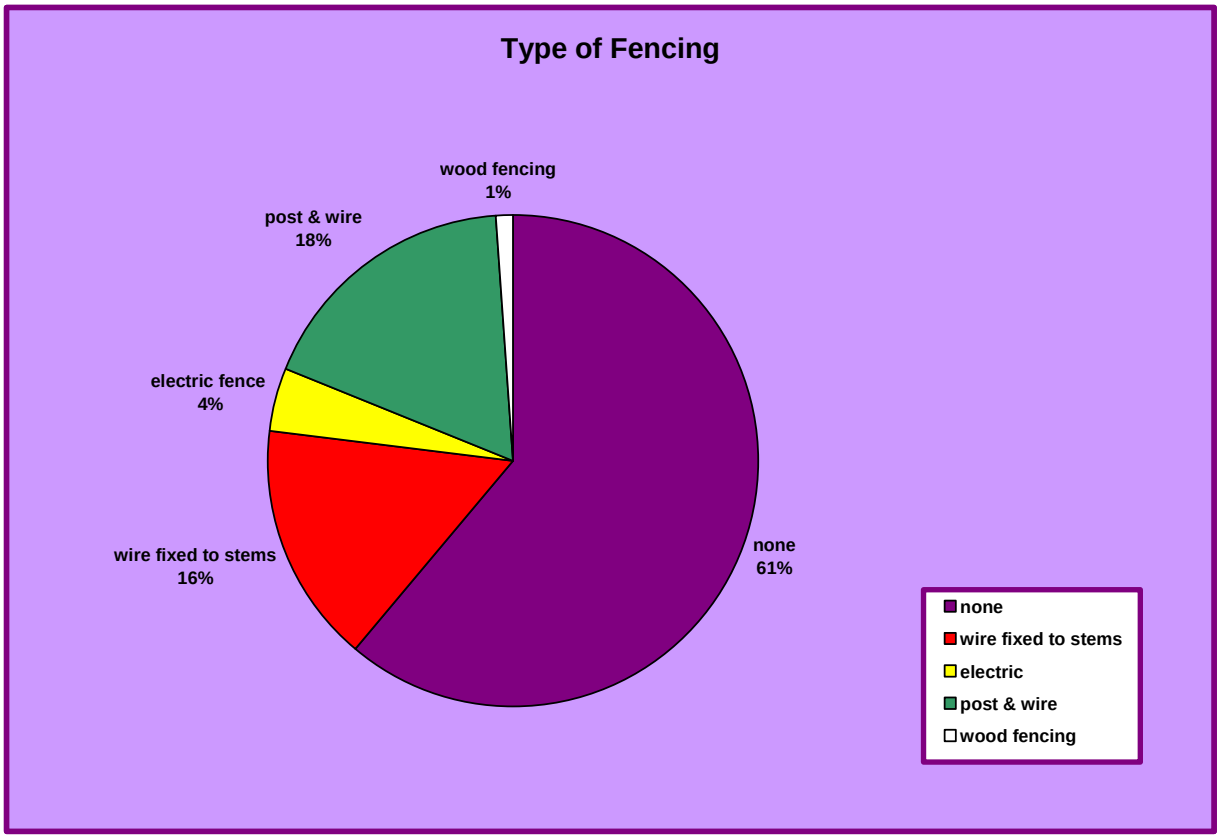


Figure 7.5.4. Breakdown of the types of additional fencing used in Fingal hedgerows.

Examples of hedgerow trees with wire fencing directly attached to their stems

7.6. Adjacent Land Use

Landscapes are dynamic features and no portion of a landscape is ever isolated from its surroundings. The way the land is used beside a hedgerow may have an effect on its vegetation, especially on the hedge-bottom flora. These effects often occur in the form of grazing, pollution, nutrient runoff, and herbicide drift. At 42%, improved grassland was the most common land-use found adjacent to hedgerows in Fingal, followed by tillage at 29% and roads and tracks at 15% (Figure 7.6a).

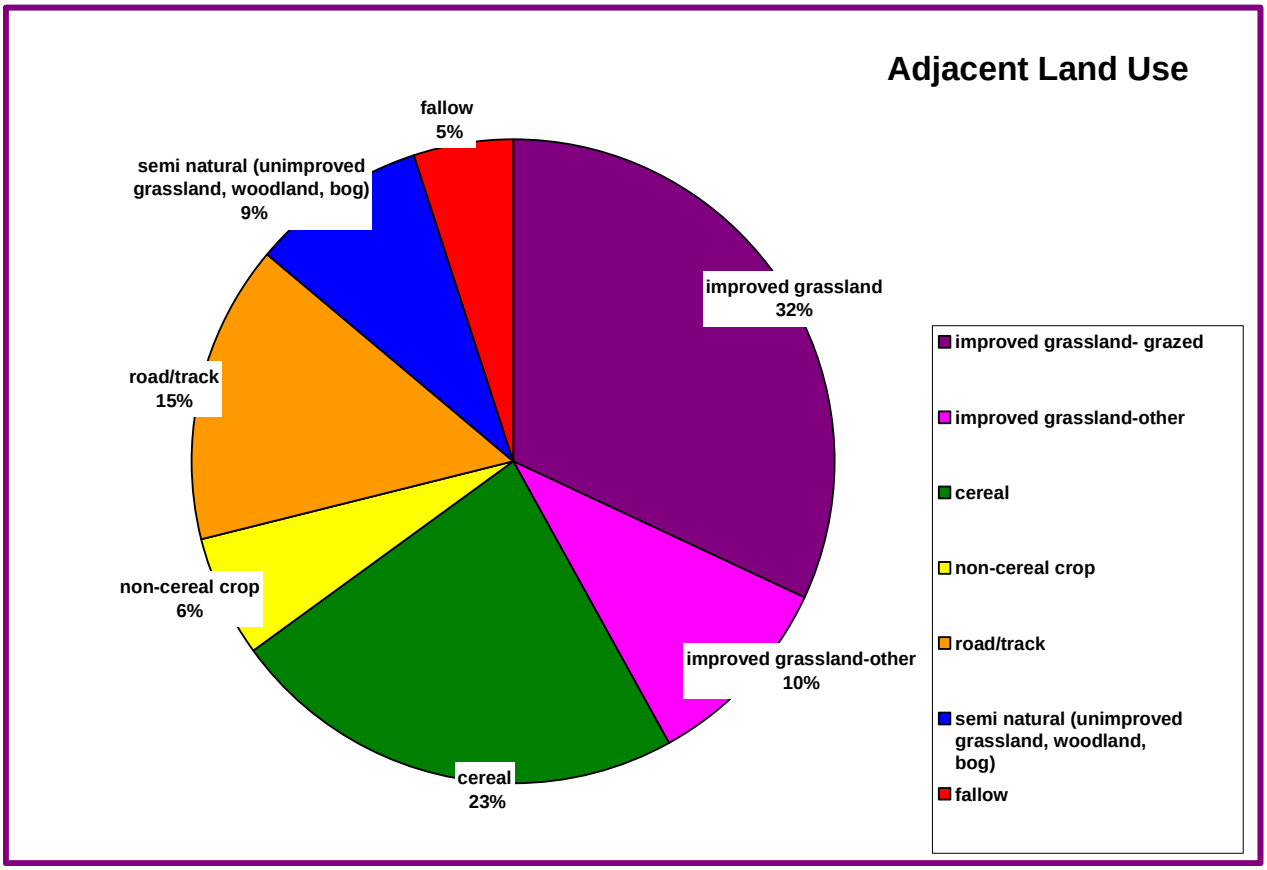


Figure 7.6a. Breakdown of adjacent land use categories for Fingal hedgerows.

The mean number of herb species found growing in the hedge-bottom was not very different for each of the adjacent land-use classes, ranging from a mean of 10.1 species for hedges beside non-cereal crops to 13.2 species for those beside fallow fields. The mode, however, supported observations made in the field, in which the number of species tended to be fewer for hedge-bottoms beside cereal crops and greatest for those adjacent to roadsides. The tendency towards "clean fields" in which the margins are physically removed or treated with herbicides may explain the fewer species that tend to occur in the hedgerows alongside tillage areas.

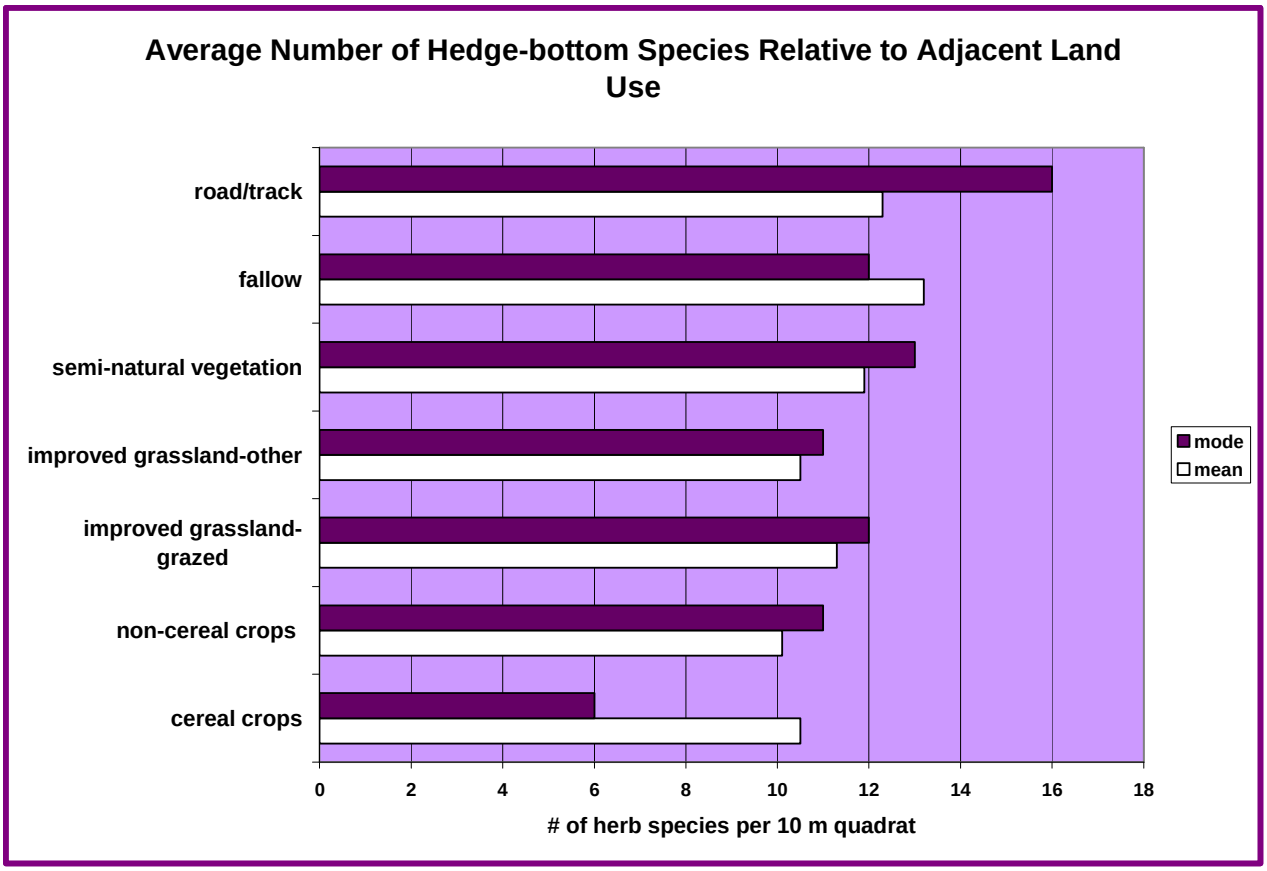


Figure 7.6b. The mean and mode of herbaceous species numbers that occur in Fingal hedge-bottom quadrats related to adjacent land use.

8.0 Fruiting of Hedgerow Shrubs

The fruiting of shrubs in the hedgerow, especially of Whitethorn (*Crataegus monogyna*), tends to reflect management practices. Hedgerows that are not heavily managed will fruit well, while those that are not managed for overly long periods of time may see reduced fruiting as the shrubs lose their vigor. Optimum fruiting, therefore, reflects management practices that are not too severe, nor absent for an excessive number of years. Fifty percent of the hedges in this survey exhibited poor to no fruiting at all, while only 11% bore a heavy crop of fruit (Figure 8.1). Hedges in which Blackthorn (*Prunus spinosa*) replaced Whitethorn were recorded as having poor to no fruiting (regardless of the presence or absence of sloes), and depending on the amount of fruiting Whitethorn present in the hedge.

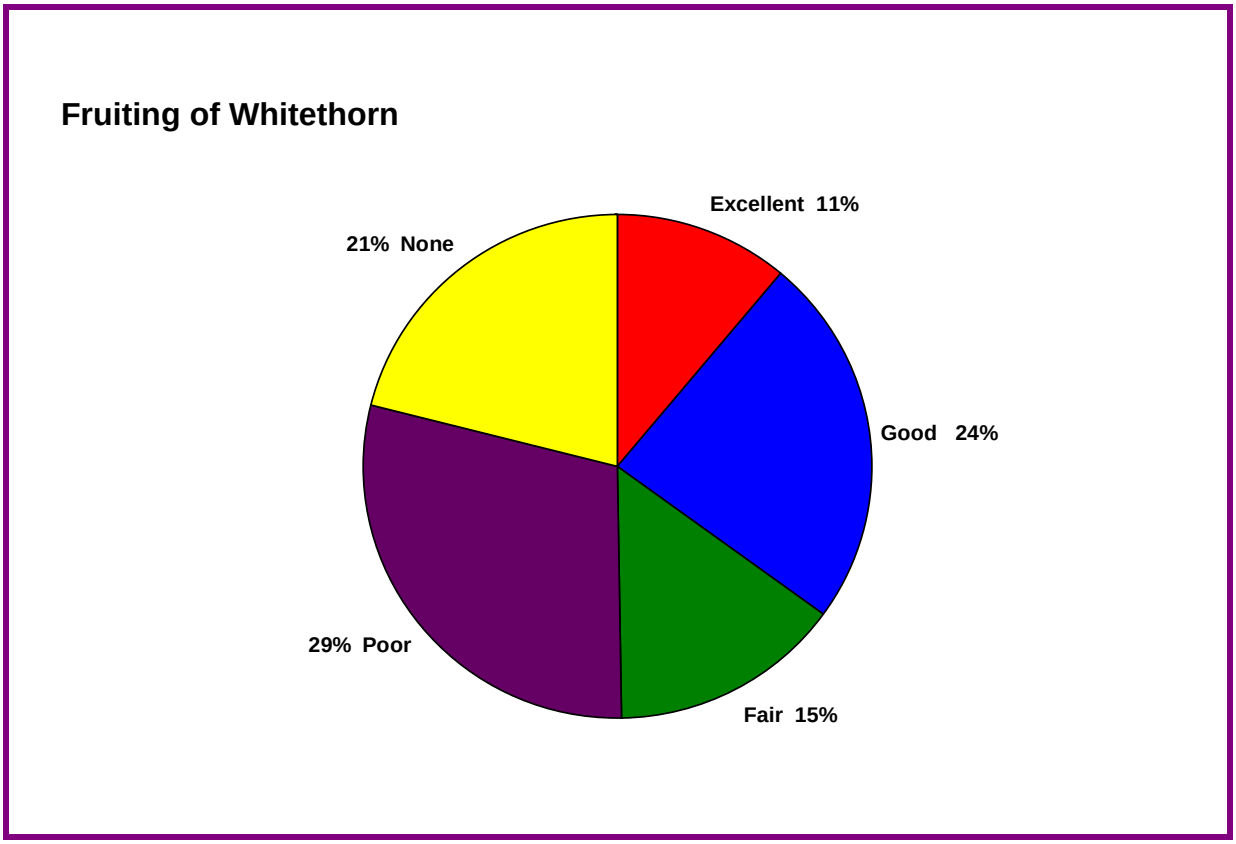


Figure 8.1. Fruiting levels of Whitethorn (*Crataegus monogyna*) in Fingal hedgerows.

The abundant fruits of Whitethorn in a hedge near Dollards, Fingal.

9.0 Current Hedgerow Management Practices in Fingal

As structurally artificial features of the landscape, hedgerows require management to maintain their suitability as boundaries. In the past, management was usually practiced by hand, while in modern times, large machines such as the bar cutter, flail and circular saw are predominantly used. A large percentage of hedgerows in Fingal are not managed at all. Nearly 40% of the surveyed hedges were apparently unmanaged in the long-term, while an additional 13% appeared to be unmanaged for at least the short-term (Figure 9.0).

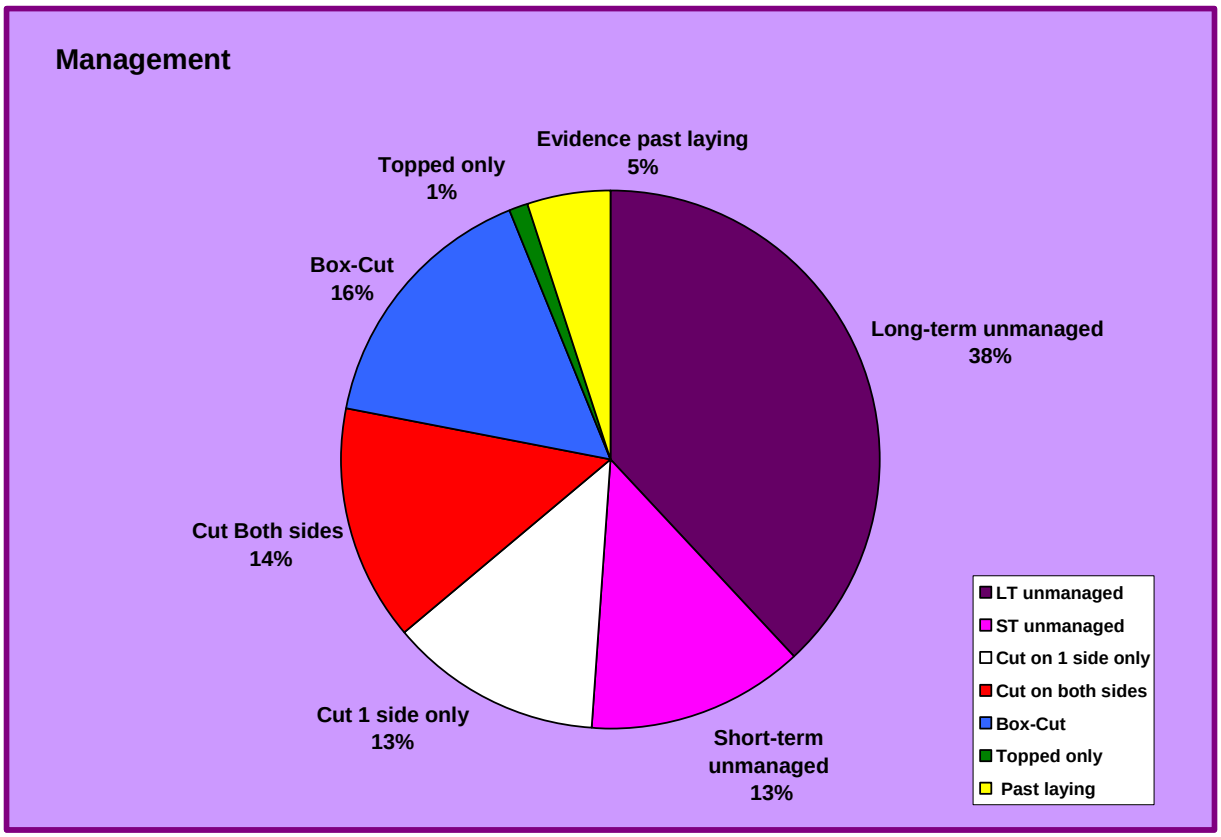


Figure 9.0. Percentage of the types of management in Fingal hedgerows.

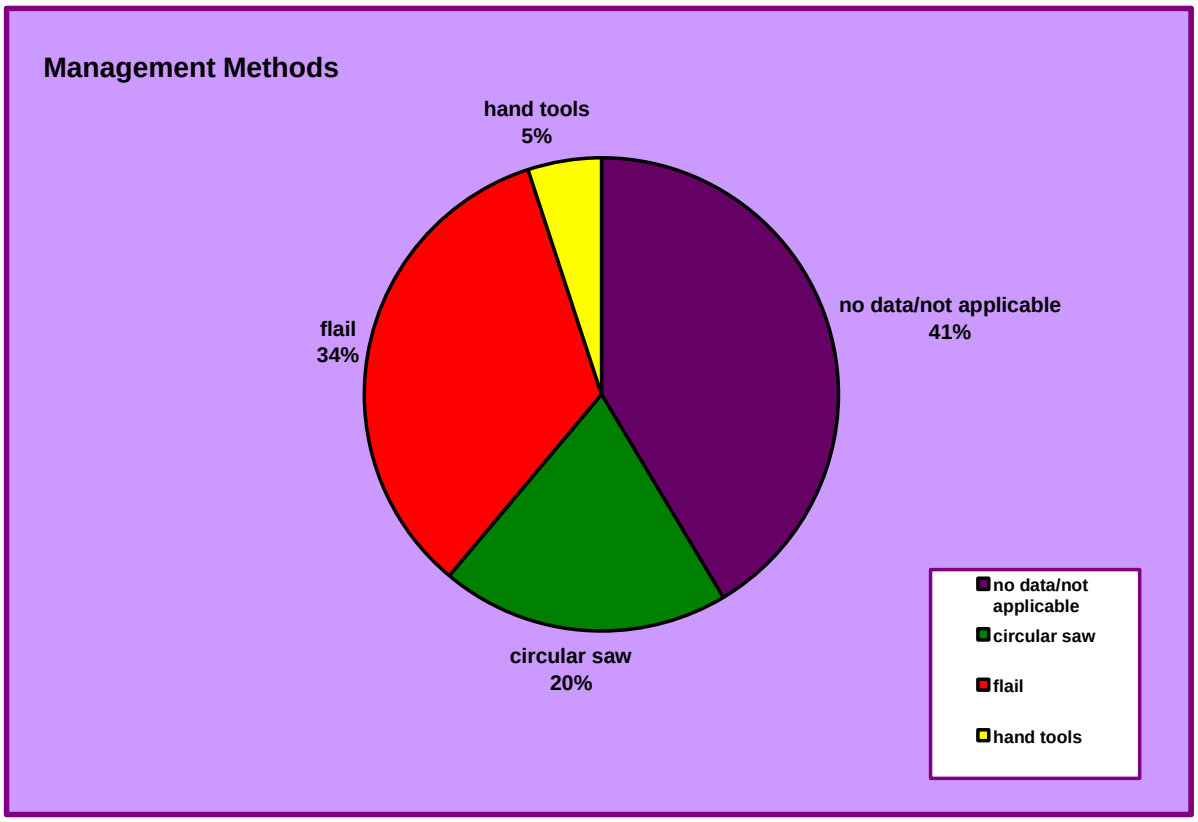


Figure 9.1. Breakdown of the hedgerow management methods used in Fingal hedgerows

Of those hedges that are managed, the flail is the dominant instrument of use (34%), especially along roadsides, where the hedges tended to be drastically cut in a "box" shape, or on just the one side facing the road. (Figure 9.1). Due to the extent of hedgerow neglect in Fingal, the methods of management for many hedges could not be determined (41%). In some older hedges however, characteristic "elbows" or primary branches bent to nearly 90 degree angles suggest that they were once managed by the traditional practice of hand-laying (*see photo on pg 14*) . Less than 5 % of the surveyed hedges showed signs of having been hand-laid in the past, with none at all in recent times.

Well-managed and structurally sound hedge in a cattle-rearing area, Charstown Fingal.

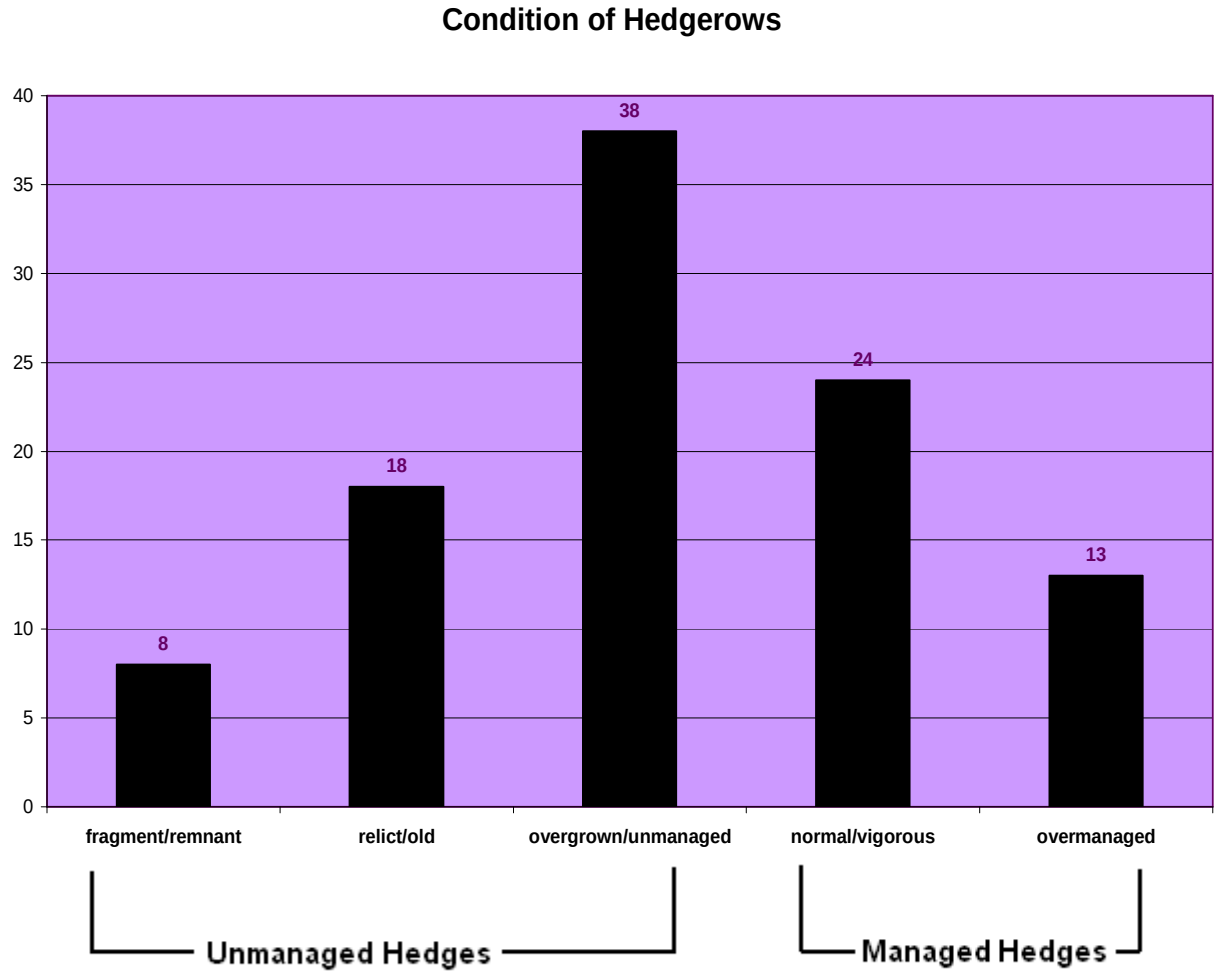


Figure 9.2. Percent breakdown of the condition of hedges in Fingal.

DISCUSSION

10.0 Extent of the hedgerow resource in Fingal

With approximately 2,660 km of hedgerows, or 5.83 kilometres per square kilometre of the region, Fingal compares favorably to some eastern Irish counties in the extent of its hedgerow resource, however, the distribution of hedgerows is not uniform across the district. Coastal areas (Rush, Lambay, Portraine, Howth) and areas that are rapidly being subsumed into Dublin's urban and suburban sprawl have few or no hedgerows (Santry, St. Catherine's, Kildonan, Mulhuddart, Malahide). Large demesnes also tend to be sparsely hedged, as they tend to be used for amenity purposes, including golf courses or open parklands (Malahide demesne, Howth demesne, Newbridge/Turvey demesnes, and St Catherine's Park). Suburbanisation of formerly rural areas appears to be accelerating the rate of hedgerow removal, as does the consolidation of small fields into larger ones. Rural areas, especially in the north and west of the district, have higher hedgerow densities, but field expansion, roadworks, home construction, and poor or non-existent management in many cases will cause the hedgerows in these areas to decline further if proper controls and management measures are not implemented. The current average density also demonstrates a continuous trend of hedgerow loss in Fingal since 1937, when the region was estimated to have a mean hedgerow density of 10.06 km/km². Since that time, however, the county has seen a decline in hedgerow densities to 9.02 km/km² in 1974, 8.60 km/km² in 1985 (Hickie 1985), and finally to the present estimate of 5.83 km/km² in 2006. This represents a net mean hedgerow *loss* of 4.23 km/km² since 1937 with 2.77 km/km², or 66% of that occurring since 1985.

11.0 Woody species richness

Compared to woodland, hedgerows are generally impoverished in woody species diversity, and Whitethorn (*Crataegus monogyna*) is usually the dominant shrub, however, a total of 9 native trees and 14 native shrub species were found in our samples. With an average of 4.2 native woody species to be found along a 30 metre section of hedgerow, many hedges in Fingal may be considered species-rich since they are over the 5 species minimum used to define species-rich hedges in Great Britain and the 4 used by Foulkes and Murray in their surveys of midland Irish counties (2005 a,b,c,d). Thirty-two percent of all surveyed hedges however, were species-poor with 3 or fewer native species per 30 metres, suggesting that there is room for improvement to enhance the biodiversity value of hedges in the locality. Caution must also be exercised when using these data to describe the woody species richness of Fingal hedgerows, because of the fact that one townland boundary hedge and one roadside hedge were deliberately singled out for study in each of the 1km square survey sites. Since these have been found to be more species-rich than inter-field and non-townland boundary hedges in Ireland (Doogue 1998, Condon & Jarvis 1989, Hegarty & Cooper 1994), their selection for comparison purposes in this study may give a somewhat inflated value for the overall species richness of hedgerows in the district.
The richness of woody species in Fingal hedgerows is also dependent on cultural factors such as the origin of the hedge, history, subsequent plantings, the adjacent land use, management of the hedge or lack thereof; and natural factors such as the species composition of the local plant communities, soil characteristics, seed banks and natural succession. All these as well as associated structural components such as banks, large drains or streams, and the signs of wild animal activity should all be taken into account when assessing the priority value of hedgerows in the region.

An additional number of woody species were present in the hedges of Fingal that were not included in the final analyses. Roses comprise a large group of species that often share similar characteristics, requiring time and expertise to distinguish them. Although *Rosa sherardii, Rosa arvensis and Rosa canina* agg. were identified and used in the final analysis, *Rosa stylosa, Rosa caesia and Rosa x scabriscula* were identified late in the survey, and only with difficulty. In order not to create a bias against the sites in which these latter species were not distinguished from *Rosa canina*, they have been collectively treated as *Rosa canina* and their cover values combined in the final analyses. *Rosa stylosa* is a rare species in Ireland (Doogue 1998), and its occurrence in Fingal's hedgerows is noteworthy. Further identification of *Rosa* hybrids and micro-species was beyond the time or scope of this survey, and the reader is referred to Doogue's (1994) discussion on the roses found in the hedges of Leinster.

Brambles, like roses, comprise a large taxon of many microspecies. In this survey, they were dealt with as two separate groups, following Doogue & Kelly (2006); *Rubus ulmifolius*, the "elm-leaved" bramble which is distinguished by its characteristic leaf shape and number (usually 5), as well as the presence of white hairs on the underside of the leaves, and "non-ulmifolius" to which all other types were classified. With nearly 100% occurrence in all the surveyed hedges, Brambles, along with Ivy, have been omitted from the species richness counts, although they were used in DECORANA and TWINSPAN analyses.

As is to be expected for the district's predominantly limestone-derived soils, native calcifuge woody species present in hedges elsewhere in County Dublin were not encountered in the hedgerows of Fingal. These include Broom (*Cytisus scoparius*), Downy Birch (*Betula pubescens*), Eared Willow (*Salix aurita*) and Rowan (*Sorbus aucuparia*). Oddly enough, the calcicolous Guelder Rose (*Viburnum opulus*) was also not encountered in this survey, although it is occasional in the district, as well as elsewhere in Ireland on alkaline soils (Doogue 1998).

Trees

Ash is the most common tree species in Fingal hedgerows with over 65% occurrence in the sampled hedges. Similar results have been found in surveys elsewhere in central and eastern Ireland (Doogue & Kelly 2006, Foulkes & Murray 2005). Oak is a common hedgerow tree in Britain, but only had 12% occurrence in Fingal hedges. Although alien tree species were found in 58% of the surveyed hedges, they occurred at low frequencies, with no more than 3 species along a 30 metre hedgerow sample. The commonest non-native species were Sycamore (30.5%) and the suckering Elms (19.5%). All the trees found in Fingal hedgerows (with the exception of Yew) occurred in both standard and shrub form, depending on the local management regimes. Many Ash trees in Fingal were observed to have been managed by coppicing, as indicated by their multi-stemmed structure. Some were coppiced quite recently (Wyanstown), while others had been coppiced in centuries past, as two large ash stools in a hedge at St. Margaret's indicated (Plate 8.0).

Irish Whitebeam (*Sorbus hibernica*), and Silver Birch (*Betula pendula*) were two unusual tree species that were encountered during the survey work. Irish Whitebeam is Ireland's only endemic tree species, and occurs at very low frequencies on limestone soils of the Central plain (Rich, et al 2005). There are only a handful of records of this species from County Dublin, with only two of these found in Fingal (Parnell & Needham 1998, Rich, et al. 2005); one individual was recorded on Ireland's Eye in 1894 and one at the Anna Liffey Mills in the Liffey Valley SAC by Praeger in

1937. It is almost never planted, therefore where it occurs rarely in hedgerows, it may be considered wild. In this survey, the *Sorbus hibernica* was also from a hedge with high woody species richness very near to a crossing townland boundary.
Silver Birch, while not a rare tree and widely planted, is rare as a native in County Dublin (Doogue, et al. 1998). The individual found in a hedge near Gormanstown may be of interest since it does not appear to have been planted, and may even be a descendant of the population recorded by Colgan in 1895 in nearby Gormanstown woods.

The dominance of Ash and relative infrequency of other native tree species in the hedges of Fingal raise the question as to whether or not schemes directed at enhancing biodiversity in the county should consider encouraging the planting of other native tree species of local provenance into the hedgerow or when creating new hedges (see Recommendations).

Plate 11.0 Ancient coppiced Ash at St. Margaret's Parish *Photo by D.L. Kelly*

12.0 Herbaceous Species Richness

Woody species are generally used alone when measuring the species richness of hedgerows in Ireland but, as previously mentioned, the woody species may be the least natural component of a hedgerow, being largely a product of planting and subsequent management regimes. This survey, therefore, explored hedge-bottom species on the premise that a hedge is not defined by its woody component alone. Hegarty and Cooper (1994) found a strong correlation between the species richness of the woody component of a hedge and that of its associated hedge-bottom flora in their study of hedgerows in Northern Ireland. In the survey of Fingal, however, there appeared to be only a weak correlation between woody species diversity and that of the field layer, indicating that other factors may be affecting the richness of the hedge-bottom flora. Future hedgerow surveys should therefore include the field layer component, where possible, for a more substantial portrait of their overall ecological and biological interest.

Although the management of the overhanging woody component may have a role to play, it would appear that adjacent land use has the greatest effect on the composition and distribution of the hedge-bottom and field margin flora. Hedges in areas of high levels of stocking or heavily managed tillage had the poorest diversity, while areas beside fallow fields, wetland, old grassland and woodland had the higher species diversity. This also appeared to be the case in Northern Ireland, where heavily managed hedges and intensive land use, such tillage and heavily managed golf greens, were strongly associated with higher nutrient content of soils, low species diversity, and an abundance of competitive, nitrogen-loving herbaceous species such as *Galium aparine* and *Urtica dioica* (Hegarty & Cooper 1994). The high frequency of these two species in Fingal hedge-bottoms may likewise be linked to intensive agricultural practices and the associated nutrient pollution.

In this survey, the width of the hedge also appeared to be correlated with herb species richness, with hedges between 4.5 and 8.5 metres in width having the greatest herb species richness. Reduced populations were found in hedges greater than 9 metres and less than 3 metres in width.

13.0 Factors Affecting Hedgerow Species Richness

The effect of the location of current and extinct woodland on species richness

Of the nine hedgerows with the highest woody species count (Table 6.6.2b) three are in the immediate vicinity of existing woodland, including: St. Catherines' (1), Howth (3), and Ardgillan (3) while an additional three are located on the site of now extinct woodlots that were present during the time of the 1837 Ordnance Survey and are indicated on corresponding maps of the region (Gormanstown 3, Hollystown 3, and Ardgillan 4). The hedge at St Catherine's appears to have been formed by assarting, in which a field was carved out of the formerly more extensive St. Catherine's wood, leaving the former wood margin as a hedge separated from the remaining woodland by the newly created field. Although still connected to the existing wood at one end, tree-plantings by the county council in the field between the hedge and the wood-margin, have ensured that it will be restored to its former status as part of St. Catherine's wood.

The remaining three hedges with the highest woody species counts are potentially ancient structures since two coincide with townland boundaries, (Hilltown 1 and 5) while one is a roadside hedge (Wimbletown 2). The species-rich hedges at Hollystown (3) and Ardgillan (4) are not only near woodland, but they also coincide with townland boundaries.

Links with other habitats

The potential role of hedgerows as refuges or "corridors" has been researched for woodland species of plants (Corbitt, et al. 1999, McCollin, et al. 2000, Pollard 1973, Roy & de Blois 2006, Corbitt, et al. 1999, Smart, et al 2001), forest carabid beetles (Burel, F. 1992), game birds (Rands, MRW 1986), and small mammals (Tew, T.E., 1994). In Fingal, due to development and intensive land use, the habitats which are linked by hedgerows are few in number, and nearly 60% of the surveyed hedgerows were linked only to another hedgerow or treeline. Natural and semi-natural habitats such as woodland, wetlands or old grasslands were linked to only 17% of the surveyed hedges. Nevertheless, the connectivity of hedges and the fact that they are often the only areas that are not intensively managed for the production of crops or livestock makes them important habitats for flora and fauna that would not otherwise survive on the open and frequently disturbed landscape. In this survey, it was found that outside of woodland, hedgerows constituted nearly the only habitat for fern species, and older hedgerows or those derived from former woodlands often contained herbs of woodland and wood-margins such as Primroses (*Primula vulgaris*), Violets (*Viola* spp.), Sweet Woodruff (*Galium odoratum*), Wood sedge (*Carex sylvatica*) and False Brome (*Brachypodium sylvaticum*). No slow-spreading geophyte species such as Bluebells (*Hyacinthoides non-scripta*) or Wood Anemone (*Anemone nemerosa*) were found in hedges near woodland, in spite of their presence in the wood proper, suggesting that hedgerows are not the "linear strips of woodland" they are often touted as. They clearly do not provide suitable habitat for all woodland species.

Although many grassland species do survive in the hedgebank, species of long-established grassland, such as orchids, were not found in the hedgebanks of Fingal in spite of their occurrence in unmanaged grassland elsewhere in the district. This may be due to shading by hedgerow trees and shrubs, the adjacent land use, and the often minimal size of the hedge margin (since intensive grazing and tillage often destroy hedge margins). Nineteen percent of the surveyed hedges were located beside or linked to a stream or open drain with running water, adding a wetland dimension and thus facilitating the survival of wetland species in the landscape. Bittersweet (*Solanum dulcamara*), for example, has been described as a species of fen woodland (Doogue et al 1998) but was often found in Fingal hedgerows, especially those with deep ditches that were not in excessive shade. Other wetland species associated with open drains and streams beside hedgerows in Fingal included Hemp Agrimony (*Eupatorium cannabinum*) Meadowsweet (*Filipendula ulmaria*), Willow-herbs (*Epilobium* spp.) and sedges (*Carex* spp.)

14.0 Roadside Hedges & Townland Boundaries

Roadside hedges and those coinciding with old townland boundaries were found to have higher overall species richness, and many contained woodland elements in both the woody and herbaceous flora, suggesting that these hedges are older. Some may even be relics of former

woodland. Landscape conservation schemes should focus on the sensitive management of these hedges, whilst their removal should be avoided wherever possible.

15.0 Hedgerow Structure

For the optimal use of hedgerows by bird species, a hedge should be at least 1.4 metres tall and 1.2 metres wide (Teagasc, www.teagasc.ie, Jan. 2007). The majority of hedgerows in Fingal were found to be between 3.5 and 5 metres wide and between 2 and 3 metres tall, however a large proportion were also found to be over 6 metres wide and tall. In addition, 64% of the surveyed hedges were unmanaged, and many were losing their structure, having to be reinforced with wire fencing in areas where a boundary remains necessary (ie, livestock areas). While reduced management may be good for the colonization of wide hedgerows by woodland species, and for the fruiting of hedgerow shrubs (thereby benefiting frugivorous birds), many hedges are in danger of disappearing altogether as the vigor of hedgerow shrub species declines. Declining shrubs and gaps in the hedgerow often lead to further deterioration of the hedge-bank, especially in grazed areas where animals are not kept away from the hedgerow, and this may lead to a decline in overall species diversity. In contrast, excessive management, as seen in some roadside hedges of Fingal, reduces woody species diversity and may allow overtaking by vigorous light-demanding herb species or brambles, further weakening the hedge structure. Also, repeated cutting at the same height every year, a process called “box cutting”, produces weakened shrubs with calloused wood and little or no fruiting. This reduces the role of hedges as a source of food and habitat for many animals, while the increase in light, and hence of competitive light-demanding species may effectively eliminate any woodland herbs from the hedgerow. In the interest of biodiversity, then, a balance must be struck between excessive management and no management at all. For overgrown hedgerows losing their structure, Teagasc, the Agricultural and Food Development Authority of Ireland, recommends (1) fencing off the hedge to allow the growth of an herbaceous base and the possible natural regeneration of hedgerow shrubs and trees; and (2) the rejuvenation of hedgerows by laying or coppicing, while fencing the area off from grazing animals to allow time for recovery (www.teagasc.ie, Jan 2007).

16.0 Hedgerow Loss & New Hedge Planting

The rapid urbanisation of the county coupled with declining hedgerow structure, expansion of roads and increasing field size are having a detrimental effect on the hedgerow resource in the district, despite commitments by authorities to the conservation and enhancement of biodiversity under the National Biodiversity Plan. The rate of hedgerow loss in Fingal has accelerated in recent years, with 66% of the loss since 1937 occurring between 1985 and the present, and with the exception of an extremely new hawthorn hedge planted on the demesne grounds at Malahide, no new hedges were encountered during survey work. This does not bode well for the future of Fingal’s hedgerow resource and steps need to be taken to encourage new plantings, to facilitate the enhancement of existing hedges, and to ensure the preservation of old hedges and their character.

RECOMMENDATIONS

17.0 Overview

As a local authority committed to enhancing the biological diversity of natural and semi-natural resources within the region, Fingal County Council has requested the establishment of guidelines for the management and conservation of the hedgerow resource in the area. All residents of the county as well as farmers, park managers, the tourist industry, landowners and developers have a stake in the condition and quality of the landscape of Fingal and, at the moment, the picture is bleak. The trend towards the rapid development of urban and rural areas, coupled with haphazard planning, increased land use and deterioration, as well as the intensification of agricultural practices in Fingal, as elsewhere, have led to a decline in natural and semi-natural habitats, including hedgerows. As previously mentioned, the rate of hedgerow loss due to construction or long-term neglect has accelerated in Fingal; with the highest rate of loss occurring between 1985 and the present survey, incidentally coinciding with the current economic boom and continued growth in both urban and rural areas. Commitment to the National Biodiversity Plan's mandate of "no net loss in the hedgerow resource" (section 2.27, *Dept. of the Environment 2002*), will require stringent conservation and mitigation measures be put in place during planning and development schemes throughout the county.

18.0 Recommendations in Relation to County Policy

18.1 Rural Developments

Unlike many European countries, Ireland currently has no restrictions on "one-off" housing developments in the countryside, and over 15,000 were built around the nation in 1999 alone with estimates for an additional 450,000 in the next 30 years at the current rate (from the *National Spatial Strategy*, in: www.irishplanninginstitute.ie, Feb. 2007). Policies RAP2-RAP4 of Fingal's Development Plan state that the creation of new housing in rural areas should be restricted to existing rural village 'clusters' to limit the detrimental effect development has on the character of the countryside, including in the form of hedgerow removal (Part V, *Fingal County Council*). In a report published by the Department of the Environment, 420 kilometres of hedgerows were removed across the nation in concurrence with sight-line requirements on new rural housing in 1999 alone (2001). This was observed to be taking place at several of the sample squares during this survey (Plate 12.0) and is in direct violation of guidelines laid out in the county's development plan, in which the objective is "to resist the removal of hedgerows and the culverting of ditches and streams within rural clusters..." Not only does development in rural areas need to re-evaluated in concurrence with policies RAP 2-4 to prevent the ribbon development and "one-off" housing that are threatening the natural and cultural heritage of rural Fingal, but sight-line requirement policies need to be adjusted to reduce or eliminate negative impacts on hedgerows, especially for the species-rich hedges that tend to occur along roadsides (Part V, Objective RCO10, *Fingal Development Plan*).

Plate 12.0. Examples of hedge removal to assist site-line requirements in rural areas. (L) Roadside hedge removed (though standards kept) at the site of a soon-to-be home (resultant debris just to the right of the picture). (R) A new "one-off" rural dwelling under construction in Fingal. Note the absence of hedgerow along the roadside drain in the foreground.

18.2 The Rural Environmental Protection Scheme and Hedgerow Biodiversity on farms

The Rural Environmental Protection Scheme (REPS) was introduced nationwide by the Department of Agriculture in 1994 to provide financial incentives to farmers to preserve the traditional character and environmental quality of the rural landscape. However, the dearth of baseline information and guidelines on how to manage or enhance biodiversity on farm landscapes has raised questions regarding the success of the REPS (Collier & Feehan 2003, Feehan et al. 2002). Quality control and more research are needed if REPS is to be successful at enhancing biodiversity on the farms of rural Fingal. In addition, incentives should be provided to those farmers and landholders not participating in REPS for the management of existing overgrown hedgerows, the planting of new hedges, and the conservation of those of interest (ie, species-rich, historically significant, or containing rare species/old individuals).

18.3 Hedgerow Conservation & Local Planning

Policy HP44 of Fingal's Development Plan (2006-2011) states that the county has an obligation to

"*promote the protection of existing woodlands, trees and hedgerows which are of amenity or biodiversity value and/or contribute to landscape character, and to ensure that proper provision is made for their protection and management, when undertaking, approving or authorizing development.*"

To comply with the development plan, and by extension, with the guidelines laid out in the National Biodiversity Plan, hedgerow removal for the purpose of development, road expansion, or consolidation of small properties in Fingal should be avoided wherever possible. Where this is not possible, a "give and take" approach should be used, in which the removal of a hedgerow requires mitigation. Possible means by which to accomplish this include:

(1) Encouraging cluster development in compliance with policies RAP2-4 of the Development Plan to reduce the impact of new housing developments on roadside hedges in rural areas of Fingal.

(2) Assisting developers with the layout of new sites in the planning phase, using the county council's GIS habitat mapping technology and database.

(3) Completion of an environmental impact assessment and suggestions for mitigation of existing hedgerow habitats made by a skilled professional *prior* to giving planning permission for new developments, especially in rural areas, or areas in which hedgerows and other habitats are present.

(4) Incentives, financial or otherwise, should be made for the conservation and management of species-rich hedgerows as well as those of historical and ecological significance.

(5) Where hedgerow removal is unavoidable, as is often the case with road widening schemes that necessitate the removal of the hedgerow on at least one side of the road, mitigation measures should be enforced, and the creation nearby, of habitat of greater or equal value; using native species of local provenance if possible should be encouraged.

19.0 Hedgerows of Roadsides and Townland Boundaries

19.1. Removal

To protect the biodiversity value of hedgerows in Fingal, measures should be put into place to stress avoidance of the removal of roadside and townland boundary hedges, as both often contain greater species richness and may preserve something of the historical and ecological legacy of bygone days. Located in one of the least wooded areas of Ireland, species-rich hedges of roadsides and townland boundaries are critical reserves of woodland biodiversity in Fingal. Along with the few remaining woods in the county, these hedges are essential sources of propagules for the conservation of genetic material to be used in the creation of new hedgerows and woodlands around the county and elsewhere.

19..2. Management of Roadside hedges

By traditionally bordering roads on both sides, roadside hedges are sometimes seen as a nuisance, and a hindrance to the Irish motorist's field of vision, whether of the landscape or the next bend in the road. As a result, many roadside hedges are removed, while those that remain may be drastically managed every year in a way that reduces their species richness and value to wildlife.

"Box-cutting" of hedges, reducing them to squared-off strips seldom more than a metre tall, was observed most often along roadsides and in tillage areas. While those hedges that are a danger to motorists should certainly be reduced in height or removed, with mitigation to compensate for their loss, those that enclose fields in open areas or along relatively straight stretches of road do not need such drastic treatment. These hedges should be allowed to grow taller with fewer cutting cycles, thus saving time and energy. Teagasc recommends that hedges be cut on 3-5 year rotations, leaving the shrubs as high as possible and allowing standard trees to grow up through it at intervals (www.teagasc.com, 2 February 2007).

As the cutting of most roadside hedges is carried out by Local Authorities, State bodies, or by Local and State subsidiaries, the level of skill attained by operators in hedge-cutting needs to be monitored, and they should be regularly updated on all new guidelines and changes in management policies that maximize the biodiversity levels of hedgerows in Fingal. Too often the wrong type of machinery was used on roadside hedges. The flail, for example, is designed to trim softwood up to a maximum of 2 cm thick (www.rspb.org.uk/countryside, 2 February 2007) yet many hedges appeared to have been "boxed" using the flail, without regard to stem width, leaving a line of ragged branches (Plate 13.0). Other cutting equipment, including the bar cutter and circular saw, need to be sharp or the shredding of large stems will also occur. These crude management practices are hostile to wildlife, and reduce the recovery time as well as the overall vigor of hedgerows.

Plate 13.0a. Roadside hedges of Fingal drastically managed by the flail.
Gormanstown, Fingal

Plate 13.0b. Poorly managed roadside hedgerow cut using an ill-sharpened circular saw.
Near Hollystown, Fingal

20.0 Management Recommendations for Hedgerows in Fingal

Recommendations in this section are largely based on the results of this survey as well as current research and trends in modern hedgerow management. As 64% of the surveyed hedgerows in Fingal appeared to be unmanaged, whilst another 13% were drastically over-managed (Figure 7.2), it is clear that present management practices need to be re-evaluated to ensure the long-term sustainability of the hedgerow resource in the county.

20.1 Trimming

Existing hedges that are of good structural condition require maintenance by periodic trimming. As mentioned in paragraph 18.4.2, Teagasc recommends that hedges be cut periodically every 3-5 years, leaving the hedge as high as possible and allowing standard trees to grow up through it at intervals (www.teagasc.com, 2 February 2007). This is supported by studies of hedgerow management on the fruiting yields of Whitethorn in lowland Britain (Croxton & Sparks 2002, Sparks & Martin 1999). There is evidence, however, to suggest that allowing Whitethorn to go for long periods without management (beyond the 3-5 year rotation) will actually increase its fruit yields, but will compromise its stock-proof structure as it becomes a tree. A balance must be struck between frequent management and the lack of it, and Teagasc suggests leaving some Whitethorn (or other fruiting shrubs) to grow up as standards in the hedge while maintaining the rest of the

hedge at the desired height. Such a diversification of the hedge structure will increase the niches available to wildlife, especially birds, and thereby enhance biodiversity.
Teagasc also recommends trimming hedgerows in a triangular shape to allow the maximum amount of light to reach the hedge base, especially on the shadier north side of a hedge, thus allowing it to remain thick, and therefore stock-proof, at the base. The consequences of allowing the woody component to grow wide at the base on the already squeezed herb species of the hedge margin have not been fully explored and this recommendation may need to be re-evaluated. At present, Teagasc's recommendation is not being put into practice on farms or along roads in Fingal.

20.2 Rejuvenating overgrown or "escaped" hedgerows

The majority of the hedges encountered in this survey were overgrown, and many had become treelines, or "escaped" hedgerows. Such hedges have lost their function as a fence and, in stock-rearing areas, are reinforced with wire fencing. Oftentimes the fencing is strung up along the remaining hedge shrubs and trees and fixed to their stems. This practice contributes to further deterioration of the hedge. Gaps in the base allow grazing and trampling of the hedgebank, causing further structural deterioration as well as loss of biodiversity as herbs and seedlings are trampled or grazed. This trend can be reversed, however. Fencing the stock away from the hedgerow and replanting or allowing natural regeneration to take place, coupled with sensitive management, can return the hedge to its former function as a barrier. Some of the older shrubs of escaped hedges can be cut off just above ground level or laid (provided that they will not be grazed) to produce thick new growth, or they can be left as standards, while encouraging new growth at the base.
It is not enough just to protect the hedgerows from further loss, their quality also needs to be improved through sensitive and effective management. Advice and subsidies should be provided by local authorities to encourage the renewal and long term survival of overgrown and neglected hedges.

20.3 Laying or Coppicing

Although formerly common in parts of Britain, the traditional craft of laying hedges by hand has never been practiced on a large scale in Ireland. Foulkes and Murray found evidence of past hedge-laying in their surveys of midland Irish counties, and Westmeath had the highest proportion of laid hedges, suggesting that the practice may have been well-developed that county. In Fingal, only 5% of the surveyed hedges appear to have been laid in the distant past, compared to 24% in Westmeath (Foulkes & Murray 2005a). The practice has been revived in Britain as an ecologically friendly means to rejuvenate an overgrown hedgerow, and it should be encouraged in Fingal.

20.4 When to Trim Hedgerows

Hedgerows in Fingal should not be cut during their active growth period since the practice involves the removal of the most productive parts of the hedge, thereby reducing its vigor. In addition, Sections 19-22 of the Wildlife (Amendment) Act of 2000 give directives for the protection of birds, many of which nest in hedgerows. The cutting of hedges during the nesting season may destroy both eggs and young, threatening bird populations, and the Act indicates that hedges should not be cut between the 1st March and the 31st of August. The best time to cut the hedge is in the winter months when the plants are dormant. This reduces stress to the shrubs and improves their recovery period, while avoiding disturbance to nesting birds. Unless safety is an issue, hedges do not need to be cut more than once every 3-5 years, while varying the height at which the hedge is cut will diversify its structure, improving its value to wildlife.

20.5 Planting of New Hedges

Oliver Rackham has stated in *The History of the Countryside* that "tree-planting is not (synonymous with) conservation; it is an admission that conservation has failed (1986)". The rate of hedgerow loss in Fingal and the neglected status of those remaining, means that existing hedges will need better protection to encourage their growth and spread, while many new hedges may need to be planted in order to ensure the long term sustainability of the resource. If so, incentives will have to be made to encourage new hedge planting throughout the county as very little is being done at the present time. In the interests of conservation, native trees and shrubs of local provenance should be used when planting a new hedge, as research has found that these are most likely to prosper under local conditions with better growth, flowering, and resistance to disease (Jones, et al 2001). The origin of the planting material should always be questioned since much of the current supply comes from Continental sources which may erode the unique genetic makeup of Ireland indigenous populations, or even fail to thrive in Ireland's oceanic climate (Hubert & Cundall 2006).

20.6 Species to Use in Planting Schemes

Many planting schemes purporting to use native species often contain a mixture of native and exotic species, and this is especially noticeable in motorway plantings throughout Fingal. Local provenance is seldom used, and many of these plantings may fail to perform well. In the planting of new hedgerows, non-native and potentially invasive species such as Beech (*Fagus sylvatica*), Cherry-Laurel (*Prunus laurocerasus*), Snowberry (*Symphoricarpos albus*), and Sycamore (*Acer pseudoplatanus*) should be avoided at all costs. They are of limited value to wildlife, while their aggressive tendencies and heavy shading may overwhelm the native species, eventually leading to gaps in the hedgerow. As mentioned in the previous section, local provenance should be used wherever possible to protect the unique genetic diversity of the indigenous stock and to improve overall performance. The support or establishment of nurseries producing planting stock from sources within the county should be developed, perhaps in collaboration with the Irish Seed Savers

Association and Crann, the Tree Council of Ireland, or Coillte, the Irish Forestry Company. Additional funding may also be developed through such a partnership.

The creation of a mixed hedge with three or more fruiting native species and a diversified structure with well-spaced standard trees tends to be the most beneficial to wildlife. An accompanying drain beside the hedge will also benefit the shrubs to be planted, as well as the hedge-bottom flora and wildlife. In areas that are waterlogged for long periods of time, Blackthorn, Alder, Guelder Rose, Ash, Pedunculate Oak (*Quercus robur*) and native Willows (such as *Salix cinerea*) may be used, as all are tolerant of water-logging.. Listed below are native species that make excellent hedging material and their use should be encouraged in planting new hedges, including those around homes and businesses.

Native shrubs/small trees tolerant of heavy pruning (to no less than 1.5m):

Whitethorn (*Crataegus monogyna*)
Blackthorn (*Prunus spinosa*)
Spindle (*Euonymus europaeus*)
Holly (*Ilex aquifolium*)
Wild Privet *(Ligustrum vulgare*)
Yew (*Taxus baccata*)
Gorse (*Ulex europaeus*)

Tall, native shrubs/small trees tolerant of infrequent trimming or coppicing (to 2 metres or more):

Hazel (*Corylus avellana*)
Crab apple (*Malus sylvestris*)
Willows (*Salix caprea, Salix cinerea)*
Guelder Rose (*Viburnum opulus*)
Wych Elm (*Ulmus glabra*)

Native standard trees (should be allowed to grow tall in the hedge)
*Those marked with an * can also be coppiced*

Alder (*Alnus glutinosa*)*
Birch (*Betula pendula*) -does not trim or coppice well
Ash (*Fraxinus excelsior*)* - may become a very large tree
Wild Cherry (*Prunus avium*)*
Oak (*Quercus robur*)* - becomes a very large tree
Whitebeam (*Sorbus hibernica*)*

20.7 Management of Hedge Margins & the Hedge-Bottom Flora

Based on the findings of this survey, all hedgerows in the county should be managed at widths between 4 and 9 metres with the retention of wide margins as an ameliorating buffer between the hedgerow flora and the adjacent land use. In stock-rearing areas, this can be accomplished by fencing animals away from the hedgerow using post-and-wire fences. While this may be more difficult to encourage in tillage areas, where farmers need to cultivate a maximum amount of land to meet slipping profit gains, financial incentives could encourage them to leave wider margins between the fields under cultivation and hedgerows. It has been suggested that this practice can reduce the effects of nutrient runoff and herbicide drift on the hedge-bottom flora (Cummins & French 1994).

Wide margin between a hedge and a wheat field at Newpark, Fingal. Wide margins should be left between hedgerows and adjacent fields to encourage herb diversity, as here.

20.7 Litter and Yard Waste

There appears to be an ambivalent view towards hedgerows in some areas of Fingal, in which they are viewed as dumping grounds for litter and yard waste. This practice can have a detrimental effect on the hedgerow, as non-degradable litter smothers the flora of hedge-bottoms and prevents seedling recruitment. Yard waste, grass clippings and other organic material can also negatively affect the hedgerow flora in the same manner as fertilizers do. Increased nutrient levels foster the growth of competitive nitrophilous species such as Nettles, Cleavers, Hogweed, Docks, Vetches and some grasses, which in turn shade out less aggressive species, reducing overall diversity. Fortunately, dumping did not appear to be a common practice. Where it does occur, however, the litter should be removed from the hedgerow, and landowners should be encouraged to dispose of waster appropriately.

Litter in a roadside hedgerow near Curragh East..

21.0. Implications for the Future

As hedgerows are artificial constructions on the natural landscape, they require some degree of management for their continued existence. Many studies, including the current survey, have found hedges to be critical reserves of native plant biodiversity in an increasingly hostile landscape from which many native species have been expelled. In order to maintain or enhance biological diversity, measures must be made to protect and sustain those hedgerows with high species diversity, improve those that are declining, and encourage the planting of new ones. Since landscape dynamics are ever-changing, it may even be that the role of hedgerows in Fingal needs to be re-evaluated, and if many are to be lost, then mitigation or the creation of effective new habitats should be made to balance the loss and protect the natural resources of the county.

21.1. Future Surveys

Once measures are in place for the improvement of the declining hedgerow resource in the county, a repeat survey should be carried out to gauge the success of management and improvement schemes and monitor the resource against further loss and degradation.
The very weak correlation between herb species richness and woody species richness of hedgerows in this survey indicates that future hedgerow biodiversity assays will also need to record the herbaceous flora and not just the woody flora.

Well-maintained hedge containing Whitethorn and Gorse, with Ash standards.
Newpark, Fingal

CONCLUSIONS

This survey comes at a critical time for the hedgerows of eastern Ireland, which are threatened by the success of the ‘Celtic Tiger’ as never before. Hedgerows throughout the county have been documented and quantified and their structure and community patterns evaluated in the light of historical and present day factors. Much room was found to exist for improvement. The density of hedgerows in the county appears to be in a continuous decline over the long-term, with neglect and mismanagement contributing to poor planning of development in rural areas as a looming threat for those remaining. Recommendations have been given, while incentives for sensitive management, the improvement of existing hedges, and the creation of new ones will all help to preserve the unique natural and cultural landscape of fair Fingal.

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Appendix I. Table of Simpson's Diversity Index results for the woody quadrats within each 1 km² sample site.

		1A	1B	2A	2B	3A	3B	4A	4B	5A	5B
ARD	**ard**	0.875191	0.73545	0.702417	0.515642	1.257835	1.257835	*1.610927*	1.782172	0.797237	0.797237
LUSK	**lusk**	0.913444	0.890177	1.103494	1.157381	0.355488	0.480649	0.723561	0.746147	1.003773	1.003773
CHARS	**chars**	0.724753	0.724753	1.197273	1.197273	1.096533	0.89123	1.230382	1.10338	1.322793	0.661256
CUR E	**cure**	0.077642	0.885005	*1.603009*	**1.772435**	1.298089	1.420735	1.437218	0.751234	1.521795	1.483121
CUR W	**curw**	*1.668226*	*1.508879*	1.313952	1.361657	0.624451	0.624451	0.528122	0.716574	1.180005	1.180005
DOLL	**doll**	0.880158	0.853327	0.882166	0.886051	1.120897	1.211408	1.088116	1.297296	1.29554	1.29554
GORM	**gorm**	**1.822401**	1.737155	*1.629566*	*1.629566*	1.807986	1.869132	1.398522	1.399565	1.390175	1.390175
HILL	**hill**	1.43766	1.299119	1.28449	1.28449	1.313947	1.443939	1.137336	1.034846	**1.73968**	**1.781607**
HOLLY	**holly**	1.482307	1.345215	0.347294	0.405618	**1.867596**	**2.259851**	1.214302	1.214302	n/a	n/a
HOWTH	**howth**	*1.490133*	*1.421945*	0.825499	0.825499	*1.525422*	*1.611061*	n/a	n/a	n/a	n/a
NEWB	**newb**	1.160379	1.104137	*1.662244*	*1.172932*	1.271889	1.257932	1.056358	0.450906	0.869781	0.929625
NEWP	**newp**	*1.551916*	*1.655868*	*1.497226*	*1.508103*	1.055149	1.055149	1.70446	**1.772659**	0.981646	0.981646
PLUCK	**pluck**	1.403973	1.289709	1.083227	1.129538	1.318674	0.720298	0.91495	0.80623	0.781348	0.711692
RUSH	**rush**	0.757686	0.595983	0.540178	0.540178	0.09982	0.09982	n/a	n/a	n/a	n/a
ST CAT	**st c**	**1.762754**	*1.503594*	*1.647695*	*1.41793*	n/a	n/a	n/a	n/a	n/a	n/a
ST. MARG	**st m**	1.139286	1.168028	1.442125	1.419717	0.856192	0.856192	1.46764	0.334694	1.471545	1.223451
WIMBLE	**wimble**	*1.608976*	*1.54493*	1.328964	1.152355	1.395836	1.331061	0.794772	0.770264	*1.5836*	*1.20244*
WYAN	**wyan**	1.311577	1.028303	1.597117	0.807032	1.37104	1.399588	**1.798585**	**1.911023**	0.940824	1.103189

Bold, yellow- highest diversity, Bold , blue- high diversity, italicized- moderate to high diversity; underlined- poorest diversity

Appendix II. Table of Simpson's Diversity Index results for the herbaceous quadrats within each 1 km² sample site.

KEY: Bold, yellow- highest diversity, Bold , blue- high diversity, italicized- moderate to high diversity; underlined- poorest diversity

	1A	1C	1B	2A	2C	2B	3A	3C	3B	4A	4C	4B	5A	5C	5B
ARD	0.585941	0.847298	0.993598	0.50287	1.00197	0.92887	*1.904697*	1.606837	1.048908	1.706398	0.587787	1.268511	1.710202	0.831786	1.876917
LUSK	1.721643	1.012466	1.755647	1.851195	0.577634	1.306252	**2.13183**	0.561684	1.734889	0.113941	0.530217	1.004474	1.859538	1.169064	1.218431
CHARS	1.741657	0.497695	*1.984522*	1.322621	1.311257	1.156659	1.245318	1.070673	1.326396	1.53037	1.461018	1.53283	**2.184137**	0 (ivy only)	0.251314
CUR E	1.499761	0.587787	1.708346	1.774016	0.616186	1.286158	**2.023158**	0.684917	*1.912841*	1.463586	*1.92794*	1.044929	1.500131	1.215485	1.883253
CUR W	1.550994	1.031698	1.048851	**2.000302**	0.221272	0.743272	*1.950517*	0.813375	Bare ground	1.233573	0.34484	*1.975058*	1.706672	0.595983	1.088864
DOLL	1.364315	0 (ivy only)	1.307826	1.842324	0.150373	1.767965	**2.207055**	0.198451	*1.980351*	**2.025354**	0.487436	*1.972633*	1.855054	1.076694	0.95636
GORM	0.785544	0.250523	1.793368	0.650724	1.045988	0.892629	1.760507	1.501701	1.544092	0.869468	1.111295	1.475221	*1.903832*	0.356278	0.496849
HILL	1.240688	0.963276	1.420874	*1.910115*	1.415911	1.670579	**2.028801**	0.095083	1.408396	0.788925	0.231938	1.102157	1.235063	0.185633	0.796747
HOLLY	1.367645	0.18067	0.992366	0.974242	0.721892	1.665008	0.884395	0.647963	1.526461	1.545364	0.387727	0.68576	n/a	n/a	n/a
HOWTH	*1.999445*	0.115339	1.724697	1.144637	0.168264	No margin	0.693147	0 (ivy only)	0.998529	n/a	n/a	n/a	n/a	n/a	n/a
NEWB	1.449388	0.805455	1.151911	1.530924	1.014411	1.295189	1.699001	1.308828	*1.981309*	1.242828	0.723737	1.365807	0.861399	0.460292	0.942262
NEWP	1.263019	0.680666	1.332227	*1.954829*	0.630804	1.647045	1.515116	0.179146	0.910385	**2.405356**	0.931025	1.300055	1.328483	1.325052	1.609438
PLUCK	1.886801	0.912144	1.540445	**2.229748**	1.322229	1.493925	**2.183238**	1.563091	1.879894	1.858174	1.4114	*1.988576*	1.777053	0.482389	**2.004649**
RUSH	0.732888	0.673729	0.77603	1.798488	0.717782	0.077642	1.091699	0.115339	1.484345	n/a	n/a	n/a	n/a	n/a	n/a
ST CAT	1.687329	1.277699	**2.346921**	0.40475	0.757012	0.613641	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ST. MARG	**3.012892**	1.07881	0.959716	1.14826	0.30119	0.09982	1.873754	0.84069	0.981822	*1.936384*	*1.917658*	1.145132	1.774731	1.138357	1.843226
WIMBLE	1.786124	0.978263	1.818969	**2.17743**	0.72852	1.548435	0.834596	0.663854	1.289516	0.62721	0.095083	0.822681	1.586758	1.504077	1.498044
WYAN	1.161512	0.216311	1.716071	**2.039072**	1.129255	1.601997	1.422099	1.634752	1.336533	1.25954	0.382992	**2.072212**	**2.098362**	0.521595	**2.037149**