RESURVEY OF LONG-TERM ECOLOGICAL MONITORING TRANSECTS AT THE PEOPLE'S MILLENNIUM FORESTS

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1. INTRODUCTION

This report details the resurvey of a network of long-term ecological monitoring transects established in 2003. These transects are located at four of the People's Millennium Forests sites and were established in areas previously clearfelled of commercial conifer forestry that are being allowed to regenerate naturally. Two of the transects also include mature stands of semi-natural woodland. The baseline survey, reported in Perrin (2004), recorded vegetation, regeneration, carabid beetles, fixed-point photography and soil data. The aim of the resurvey was to record using the same methodology the changes, six years on, in all of these aspects with the exception of soil data.

This report is accompanied by a DVD with Turboveg format databases containing all floristic data for 2003 and 2009. Regeneration and tree structural data are presented in Microsoft Excel format. Digital photographs for both years are also included.

2. METHODOLOGY

2.1 Study sites

The four sites within the monitoring network are Ballygannon Wood, Co. Wicklow, Cullentra Wood, Co. Sligo, Coill an Fhaltaigh, Co. Kilkenny and Rosturra Wood, Co. Galway. There is one 200 m transect at each site divided into forty contiguous, unmarked 5 x 5 m plots. Transects were relocated through a combination of plot diagrams from 2003 depicting the position of individual trees, fixed-point photographs and GPS grid references. Bags of nails buried at either end of the transects in 2003 were not utilised.

2.2 Regeneration survey

In each plot, seedlings (height < 50 cm) were tallied for each species, whilst the height of each sapling (height $\geq$ 50 cm, dbh[1] < 3.2 cm) was measured. For all adult trees (dbh $\geq$ 3.2 cm), the dbh was measured and the position marked on a diagram of the plot. Plot diagrams from 2003 were used to relocate individual trees. Losses and recruitment to the adult tree class were noted.

2.3 Vegetation survey

Vascular plants and bryophytes were surveyed between June and September 2009. Within each plot all species were identified and assigned a percentage cover score based on vertical projection. Cover was estimated to the nearest 5%; if less than 5% a score of 3%, 1%, 0.5% or 0.1% was given. Nomenclature followed that of the checklist of Irish species produced by the National Biodiversity Data Centre. This is largely based on Stace (1997) for vascular plants, Smith (2004) for mosses and Paton (1999) for liverworts. Cover scores were also assigned to litter, bare soil, dead wood and rocks.

2.4 Carabid beetle survey

Pitfall traps were employed to investigate carabid beetle diversity along the transects. One pitfall trap was located at the centre of each 5 x 5 m plot. Traps consisted of a plastic beaker sunk into the ground so that the top was flush with the surrounding soil (8 cm diameter opening). This was part filled with a 25% solution of ethylene glycol (blue antifreeze) to kill and preserve specimens. A few drops of detergent were added to each trap to reduce

[1] * dbh = diameter at breast height, where breast height is 1.30 m

surface tension. Traps were covered with a 10 x 10 cm piece of corriboard raised 2 cm above the top of the beaker by nails at each corner; this prevented the trap from being filled with rainwater and litter, and aided in relocation of each trap. Traps were established at each site in late June and were checked, emptied and refilled at 4 week intervals in July and August. Specimens were stored in antifreeze solution until a stratified subset could be identified in the laboratory. Identification was made using Lindroth (1974) and Forsythe (1987) and nomenclature followed Anderson *et al.* (2000). Carabid records were summed for each trap over the survey period.

2.5 Photographic survey

A series of digital photographs was taken at each site, one from each plot. Photographs were taken standing from the edge of the plot nearest plot 1 viewing along the transect towards the horizon in the direction of plot 40. The purpose was to record the overall vegetation type and structure viewed from that point, rather than details of the vegetation within that particular plot.

2.6 Data analysis

Changes in the overall variation in vegetation were explored using NMS (Non-metric Multidimensional Scaling) ordination. The following parameters were used: maximum number of iterations = 100; instability criterion = 0.0005; starting number of axes = 6; number of real runs = 10; number of randomized runs = 20. Changes in species composition were examined using the Broad Habitats Classification of Hill *et al.* (2004). Species that are listed by Hill *et al.* (2004) only for woodland habitat were denoted as woodland specialists. Species that are listed for both woodland and non-woodland habitats were denoted as woodland generalists. Species that are not listed for woodland habitat were denoted as non-woodland species. Using dummy variables, mean weighted values for each plot were calculated using Turboveg 2.0. Mean weighted values were also calculated using the British and Irish calibration of Ellenberg indicator values presented in Hill *et al.* (2004). The diversity of recorded species was analysed by examination of species richness, the Shannon diversity index (which emphasises species richness) and Simpson's index (which emphasises dominance). Statistical analysis was conducted using PC Ord 5 and GraphPad InStat.

3. RESULTS

3.1 General results

In total, 160 vascular plant species and 105 bryophyte species were recorded in 2009 compared with 164 vascular species and 71 bryophyte species in 2003. In addition, 1,208 seedlings, 2,749 saplings and 606 adult trees were recorded in 2009 compared with 2,404 seedlings, 950 saplings and 514 adult trees in 2003.

3.2 Transect descriptions

In this section the general descriptions of the transects made in 2003 are presented (with minor editing) together with a description of the main changes that had occurred by 2009. Further detail on regeneration and community types is presented in later sections.

Cullentra Wood

2003 description: The transect at this site is located in Cullentra Wood proper on the headland to the east of Trawane Bay, whereas the millennial plantings are located largely to the west of the bay. The area selected for survey is to the west of the forestry road at about the highest point on the headland. One end of the transect, plot 40, starts on a wet, heather-dominated (*Calluna vulgaris*) clearfell with abundant birch (*Betula pubsecens*) and non-native conifer regeneration, and runs across several decaying windrows. This area was felled around 1998 and the previous conifer crop was lodgepole pine (*Pinus contorta*). It descends down a steep slope through a small area of birch woodland into an area clearfelled more recently in 2001 and where the brash has not been windrowed. The previous conifer crop here was a mixture of Douglas fir (*Pseudotsuga menziesii*) and Sitka spruce (*Picea sitchensis*). These three areas are all on acidic peaty soils over schist, but at this point the underlying geology changes and the final stretch of the transect is through a small area of ash (*Fraxinus excelsior)* – hazel (*Corylus avellana*) woodland over limestone, with a thin lithosol covering. Plot 1 is located at this end of the transect.

2009 description: There has been remarkably little change in the clearfell sections of this transect in the past six years. In the heather-dominated section, birch is colonising but succession is markedly slower than at either Rosturra or Coill an Fhaltaigh. High grazing pressure from deer is certainly an influencing factor; although the area in which the transect is located has been deer-fenced it is patently being ineffective. There is still a considerable amount of non-native regeneration but the remains of cut saplings indicate that some

management has been undertaken in this regard. The windrows that were clear features in 2003 have now largely rotted down and are indistinct. In the birch stand on the slope several mature trees have been lost. Grazing pressure in the limestone woodland is also very high with a scant field layer and little regeneration.

Coill an Fhaltaigh

2003 description: The transect at this site is located in the "Conservation Area" that lies just to the southeast of the car-park and runs parallel with the path for the full extent of the area. Plot 1 is at the end nearest the car-park. This site was felled in 1999/2000 and the previous conifer crop was Norway spruce (*Picea abies*). The transect is relatively uniform in comparison to the others, running throughout its length through a poorly draining, rush-dominated (*Juncus* spp.) clearfell. There is no evident windrowing of brash at this site, but diversity is increased by numerous drains which criss-cross the area. Regeneration is chiefly by grey willow (*Salix cinerea*) and ash. During the felling of the conifer crop at this site mature pedunculate oak (*Quercus robur*) was retained where possible (Kevin Ryan pers. comm.); these trees occur as scattered, rather spindly individuals across the site. The soil is strongly gleyed and is underlain by heavy clay that is exposed where ditches have been cut.

2009 description: There have been significant changes at this site, with vigorous regeneration of grey willow and ash that now form dense thickets 2-4 m high in places. These form a mosaic with bramble (*Rubus fruticosus* agg.) and dog rose (*Rosa canina*) that have grown rampant, making re-marking the transect and subsequent surveying rather challenging. Rushes, so abundant in 2003, have been largely out-competed and most ruderal species have been lost. Towards the end of the transect where plot 40 is located, the succession is more advanced and an area dominated by grey willow and ash with a closed canopy occurs. This is a lowland site in an agricultural landscape that has been fenced and appears to be subject to little if any large herbivore grazing.

Ballygannon Wood

2003 description: The transect at this site is located to the east of the Rathdrum-Laragh road, whereas the millennial plantings are to the west of the road. The area surveyed lies at the bottom of the forestry track that descends from the car park, behind a commemorative bench. This is the site with the earliest felling date of 1987-1988, and is currently covered in immature birch woodland. The previous conifer crop was Norway spruce (*Picea abies*). The

transect runs from plot 1 in a seasonally flooded area where birch (*Betula pubsecens*) is co-dominant with grey willow, through a drier area dominated by birch alone, a more open area with abundant bracken (*Pteridium aquilinum*) and finally an area where young sessile oaks (*Quercus petraea*) are frequent amongst the birch near plot 40. The soil is largely a brown earth with small areas of gleying.

2009 description: There has been relatively little change in the vegetation types at this site. The stand is aggrading, with many of the smaller birch having been lost due to competition with the larger trees. This site is unfenced and being in the uplands of Co. Wicklow is subject to deer grazing that has resulted in a rather sparse or grassy field layer that has changed little since 2003.

Rosturra Wood

2003 description: The area surveyed at this site is in the compartment marked as "Natural Regenerating Area" that lies on the northern boundary of the site. This is the most recently clearfelled site (probably 2001 or 2002). The transect runs across a sparsely vegetated clearfell and across several very large (1-2 m high) windrows. The soil consists of a thin, peaty "duff" topsoil derived from litter of the previous conifer crop, beneath which is a sandy, partially gleyed material. Drainage is therefore impeded for most of the site. Regeneration is represented by an abundance of willow and birch seedlings, and towards the centre of the transect alder (*Alnus glutinosa*) saplings are present. The end of the transect denoted by plot 1 is located within an area of oak-holly (*Ilex aquifolium*) woodland.

2009 description: There has been little change in the area of mature oak-holly woodland which is seasonally flooded in places and retains a field layer of remote sedge (*Carex remota*), soft rush and greater wood-rush (*Luzula sylvatica*). However, the clearfell area has changed considerably. The central part of the transect has developed into a dense stand of young birch 3-4 m high. Alder is locally abundant. The section of the transect towards plot 40 has largely been colonised by gorse (*Ulex europaeus*) that now forms a dense scrub with heathy elements. The windrows are still distinct and are marked by dense patches of bramble (*Rubus fruticosus* agg.). There is fairly frequent regeneration of Sitka spruce (*Picea sitchensis*).

3.3 Regeneration and tree data

Plot diagrams for 2009 are presented in Appendix 1. Summary data tables for trees and regeneration are presented in Tables 1-6 in Appendix 2.

Cullentra

At Cullentra, regeneration (Tables 1-3) consists largely of birch saplings that have colonised the wet heath community. Overall density has more than doubled but birch mean height has increased little since 2003. Ash seedlings were abundant in the limestone woodland area in 2003, but are much scarcer now. Despite some apparent management measures to control non-native regeneration, four alien conifer species are still regenerating in the heath area. The mature tree data (Tables 4-6) shows a general increase in basal area and mean dbh for most species, but there has been little change in stand composition due to lack of recruitment.

Coill an Fhaltaigh

This site still has the widest variety of regenerating species, with seedlings or saplings of birch, hazel, ash, holly, grey willow, pedunculate oak, guelder rose (*Viburnum opulus*), hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*), hybrid willows and goat willow (*Salix caprea*). Ash and grey willow are the most prolific species, however, and have increased considerably in both sapling density and height. There has also been a resulting recruitment to the adult size class of several species; grey willow is the most successful with an average density of nearly two trees per plot. Non-native regeneration of sycamore (*Acer pseudoplatanus*), beech (*Fagus sylvatica*) and Norway spruce (*Picea abies*) was recorded and there are now some non-native adult trees present. The mature but rather spindly pedunculate oaks left behind after the clearfelling are still present and their crowns have filled out; it was speculated back in 2003 that these might succumb to high winds.

Ballygannon

At Ballygannon, sapling density overall was lower than in 2003 due largely to a loss of birch saplings and holly is now the most abundant sapling. The mean heights of birch and ash saplings have increased. Non-native regeneration is sparse but there is a patch from plots 28 to 36 where sycamore and Lawson's cypress (*Chamaecyparis lawsoniana*) are fairly frequent and there has been recruitment to the adult tree class by these species. The densities of ash, holly, oak and grey willow trees have increased whilst birch tree density has

declined, an indication that stand composition is starting to diversify as this stand matures. Basal area of most species has increased.

Rosturra

At Rosturra, there have been huge increases in birch and grey willow sapling densities, with an average in 2009 of 34.5 birch saplings and seven grey willow saplings per plot. A variety of other native species are regenerating including alder, hazel, ash, holly and rowan (*Sorbus aucuparia*). Sitka spruce saplings are also fairly frequent. Mean heights for alder, birch and grey willow are also much greater now. Alder, birch, grey willow and Sitka spruce have been recruited to the adult tree class.

3.4 Vegetation analysis

The NMS ordination found a three-dimensional solution (Fig. 1). The stress on (or robustness of) this solution was 16.4 which was statistically significant (Monte Carlo test, $p < 0.05$); according to McCune & Grace (2002) this is quite satisfactory for an ecological dataset. The three axes accounted for 71.8% of variance in the dataset but only two axes are used here for clarity. Axis 1 largely represents an acidic-basic gradient, being correlated with pH, organic soil content, and Ellenberg's reaction and nitrogen indices. At the lower end of this axis are found the thin, base-rich limestone soils of plots 1 to 9 at Cullentra and the heavy, gleyed soils of Coill an Fhaltaigh. At the higher end of this axis are the highly organic soils from the heathy other end of the Cullentra transect. Axis 2 represents a successional gradient, being correlated with basal area and the abundance of woodland specialist and non-woodland species. At the lower end of this axis, woodland and scrub communities are found, whilst open clearfell and heath communities are found at the higher end.

The degree of change in vegetation between 2003 and 2009 varied markedly between sites (Fig. 2). The largest movements were the clearfell plots from Coill an Fhaltaigh and Rosturra which have moved large distances down Axis 1. There is considerable variation in the composition of the plots from Cullentra, but it is clear that succession here has proceeded much more slowly than at Coill an Fhaltaigh and Rosturra. At Ballygannon there has been an overall movement of plots down this successional gradient but it is far less significant; this is to be expected of a site which is more advanced towards mature woodland.

Figure 1 *NMS ordination of vegetation data from Millennium Forest long-term monitoring plots. Circles indicate 2003 data, triangles indicate 2009 data. Cullentra plots are in gold, Coill an Fhaltaigh plots are in green, Ballygannon plots are in red and Rosturra plots are in blue. Vectors indicate correlations of environmental data and plant attribute data with the axes; longer lines indicate stronger correlations. Wspecial = Woodland specialist species, Wgeneral = woodland generalist species, Nonwood = non-woodland species, Basal = Basal area of adult trees, %Organic = % loss-on-ignition of 2003 soil sample, pH = pH of 2003 soil sample. Other variables are mean weighted Ellenberg indicator values.*

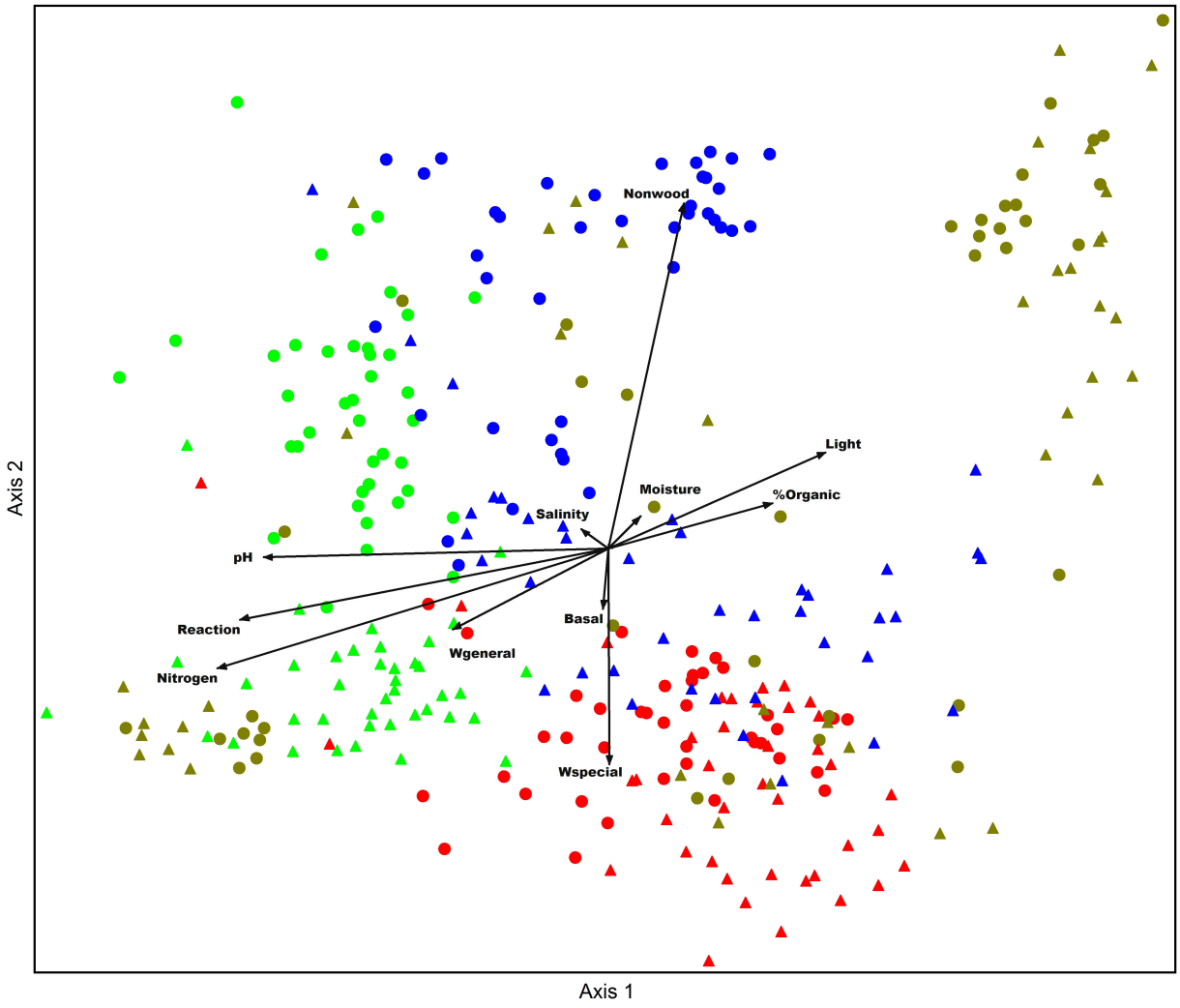
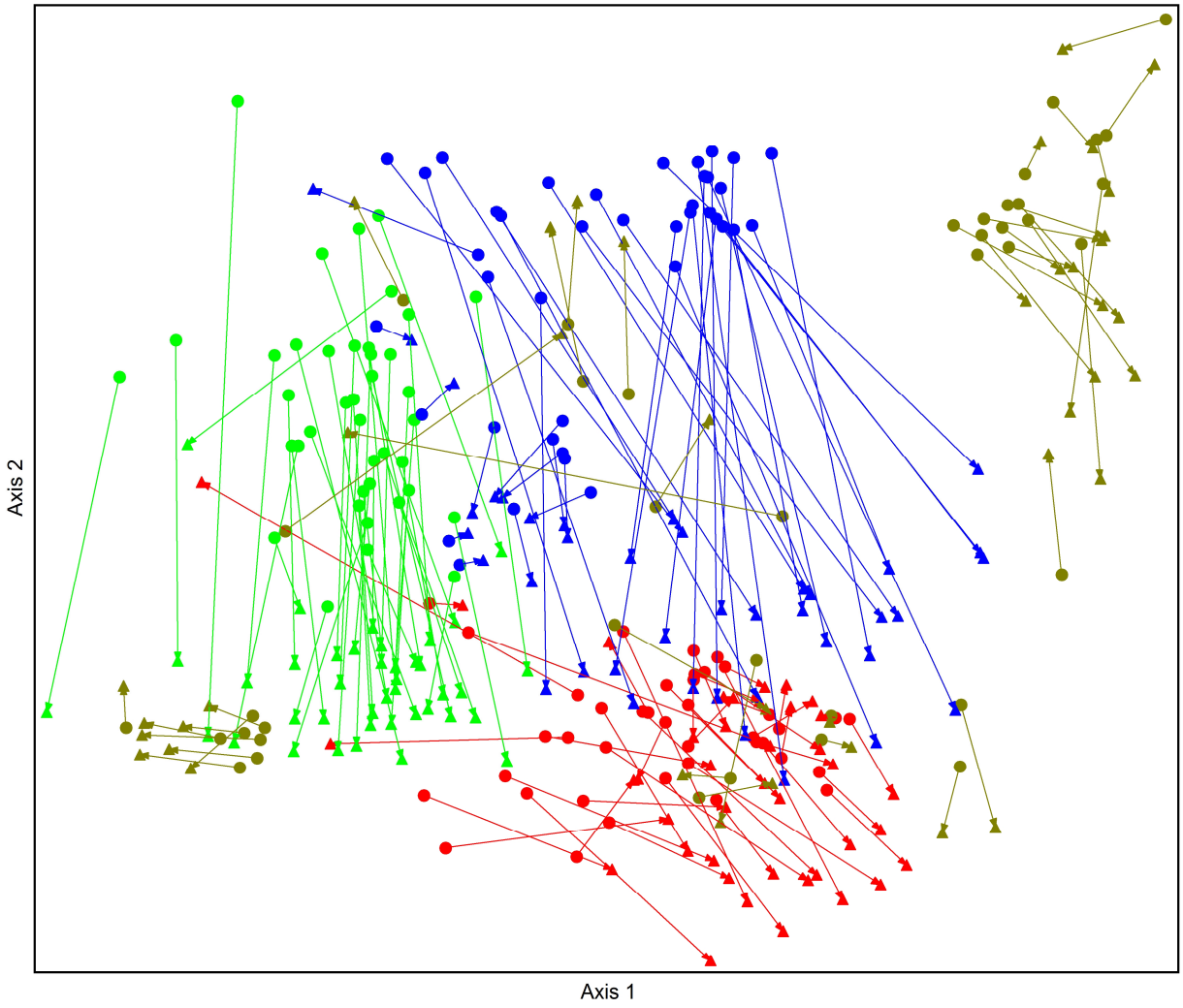
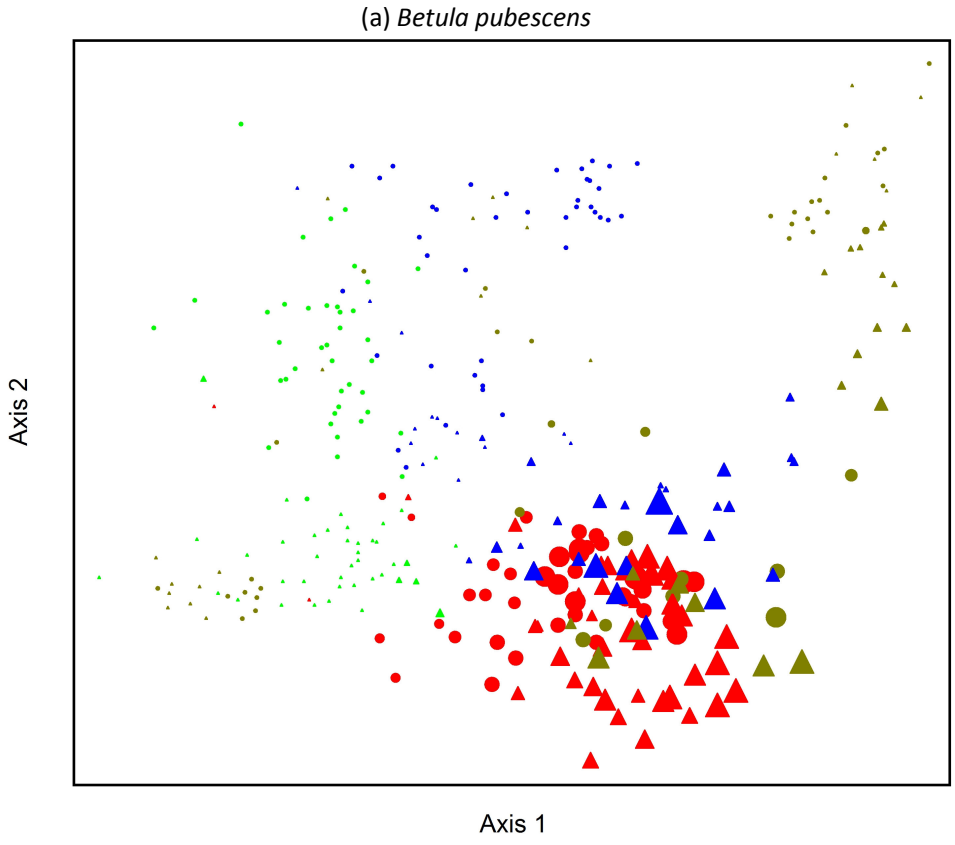


Figure 2 *NMS ordination with successional vectors showing movement of plots in ordination spaces between 2003 and 2009. Circles indicate 2003 data, triangles indicate 2009 data. Cullentra plots are in gold, Coill an Fhaltaigh plots are in green, Ballygannon plots are in red and Rosturra plots are in blue.*

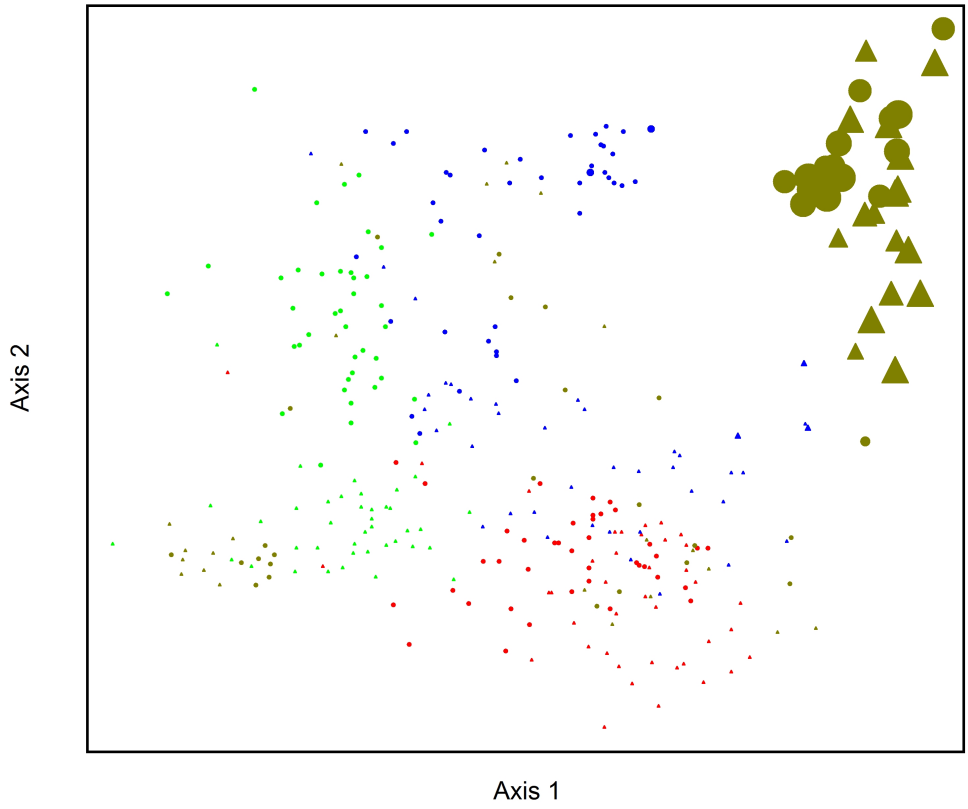


Changes in overall species composition were assessed by visual inspection of how the abundance of key species varied within ordination space (Fig. 3a-k). This was used to indicate the different community types recorded so far during monitoring (Fig. 4). Some communities are fairly well defined, e.g. the *Fraxinus excelsor* woodland and *Calluna vulgaris* heath. Other communities are more disparate in nature, particularly the open clearfell communities.

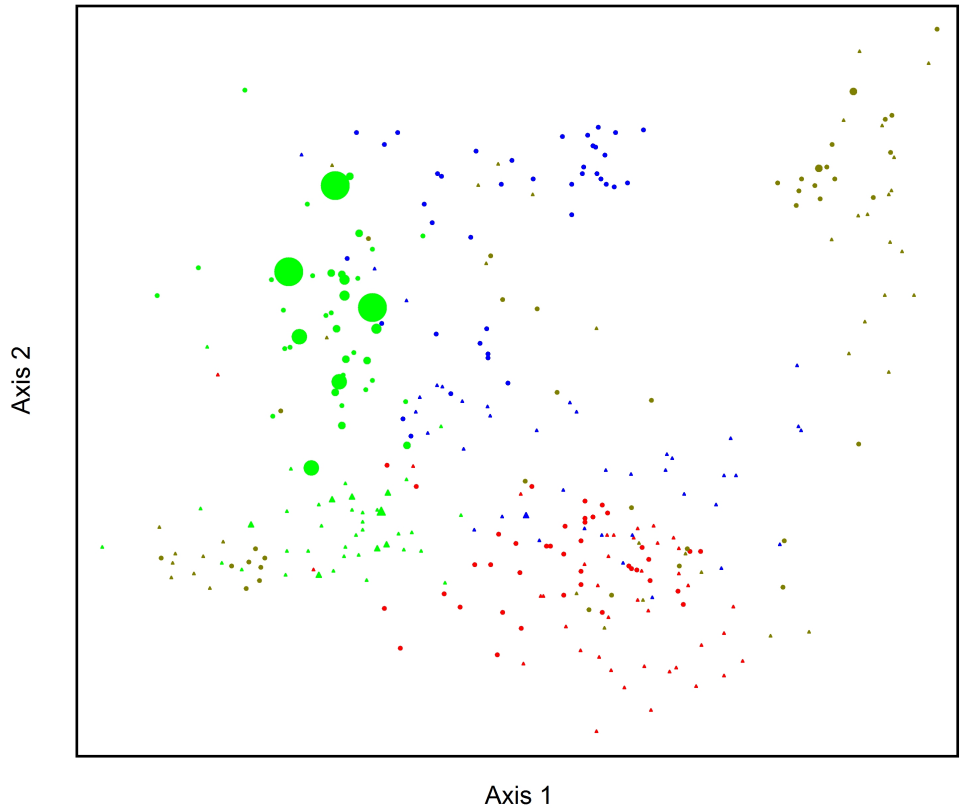
Figure 3. *NMS ordination showing abundance of different species. Circles indicate 2003 data, triangles indicate 2009 data. Cullentra plots are in gold, Coill an Fhaltaigh plots are in green, Ballygannon plots are in red and Rosturra plots are in blue.*



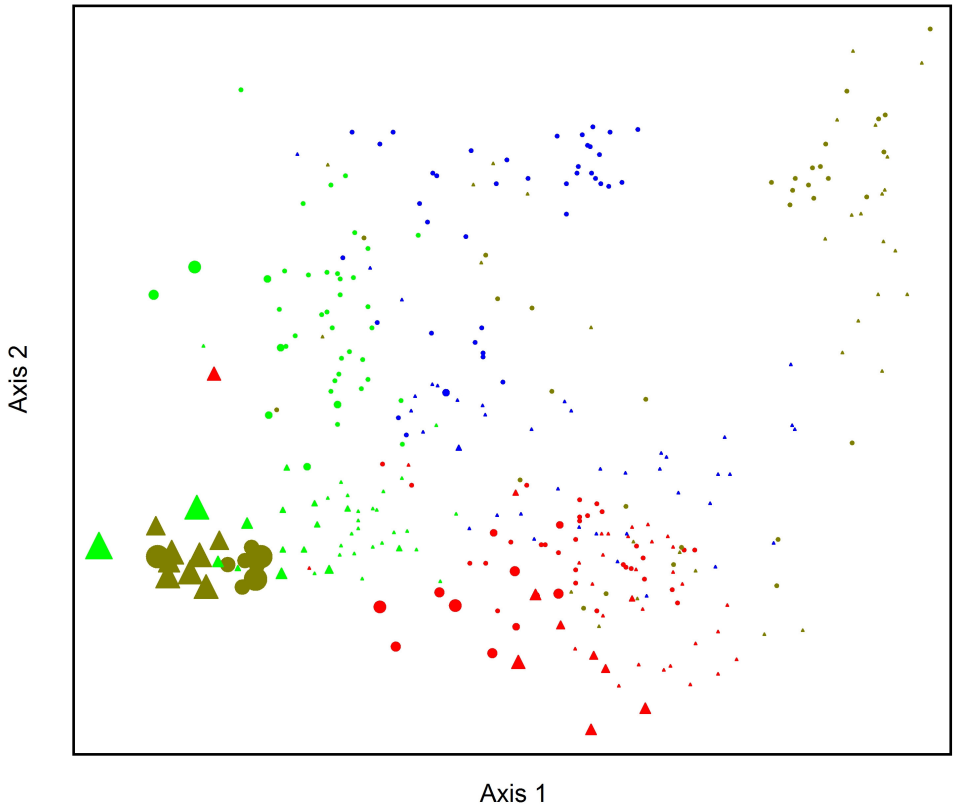
(b) *Calluna vulgaris*



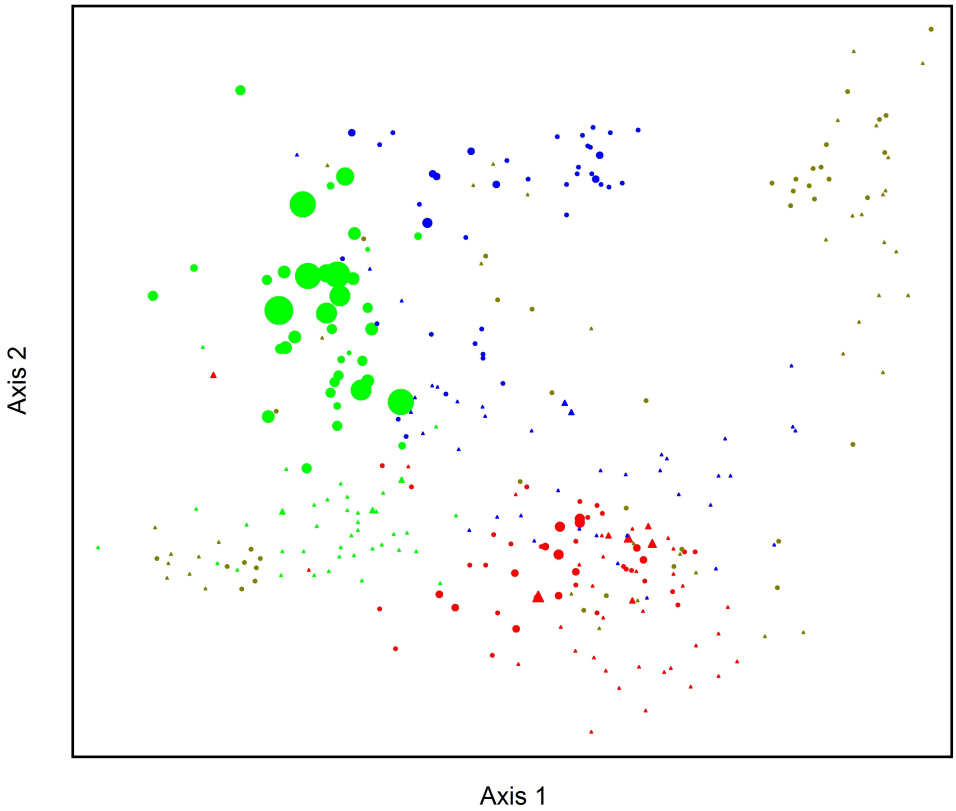
(c) *Chamerion angustifolium*



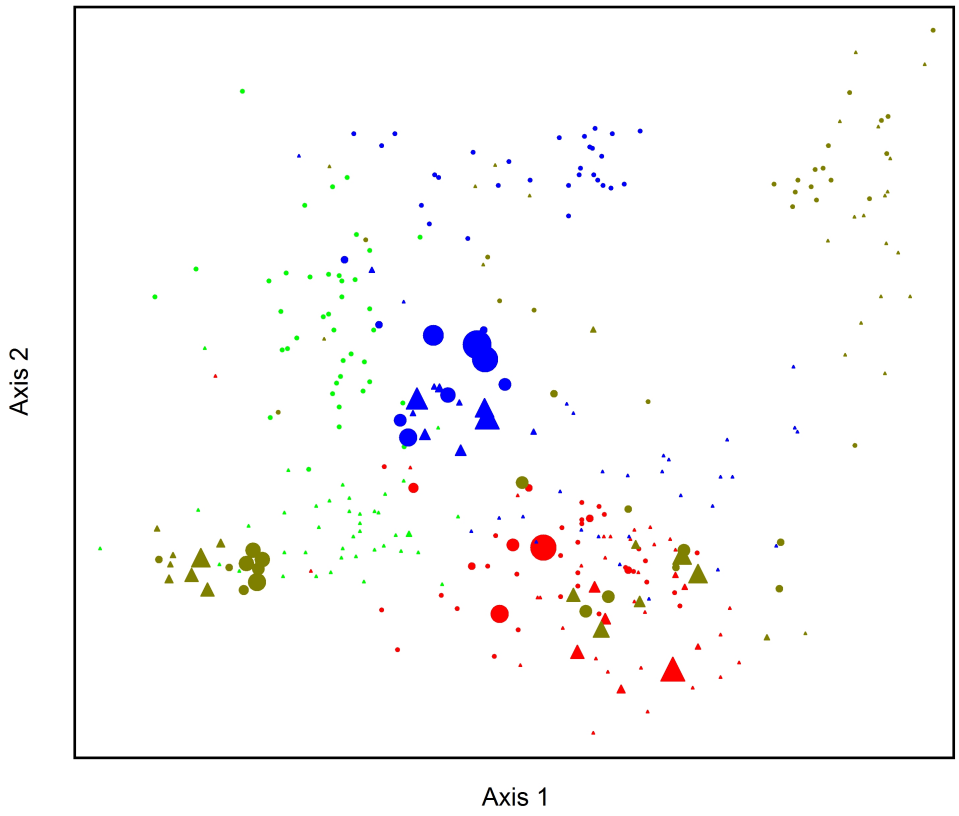
(d) *Fraxinus excelsior*



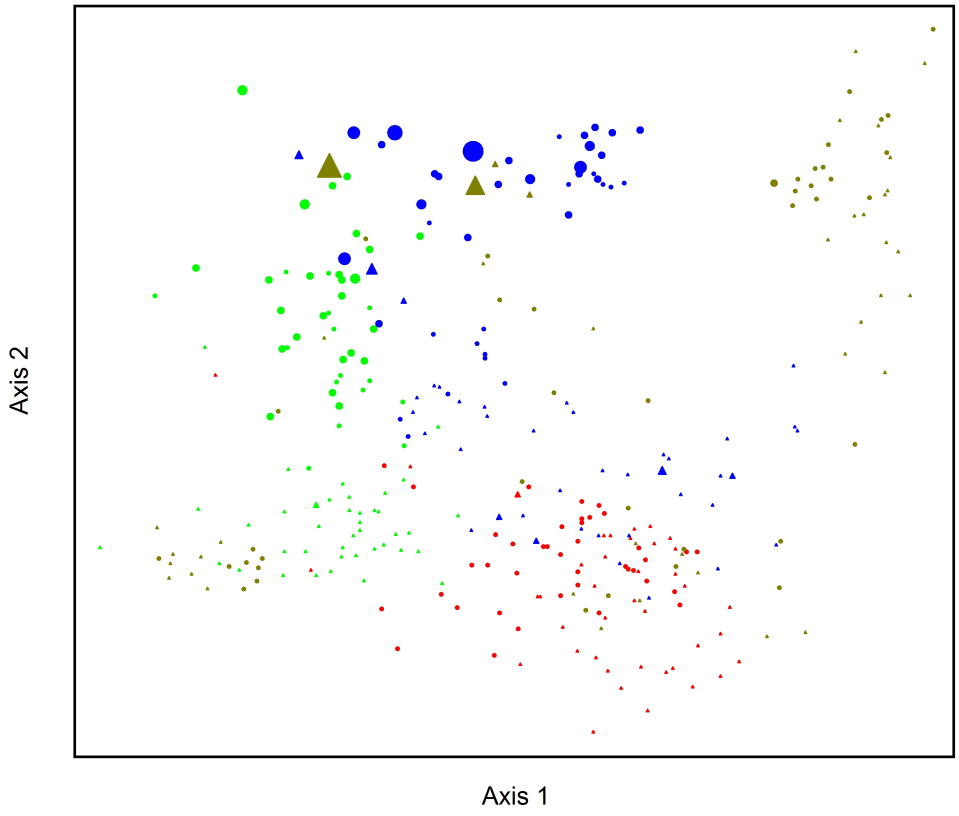
(e) *Holcus lanatus*



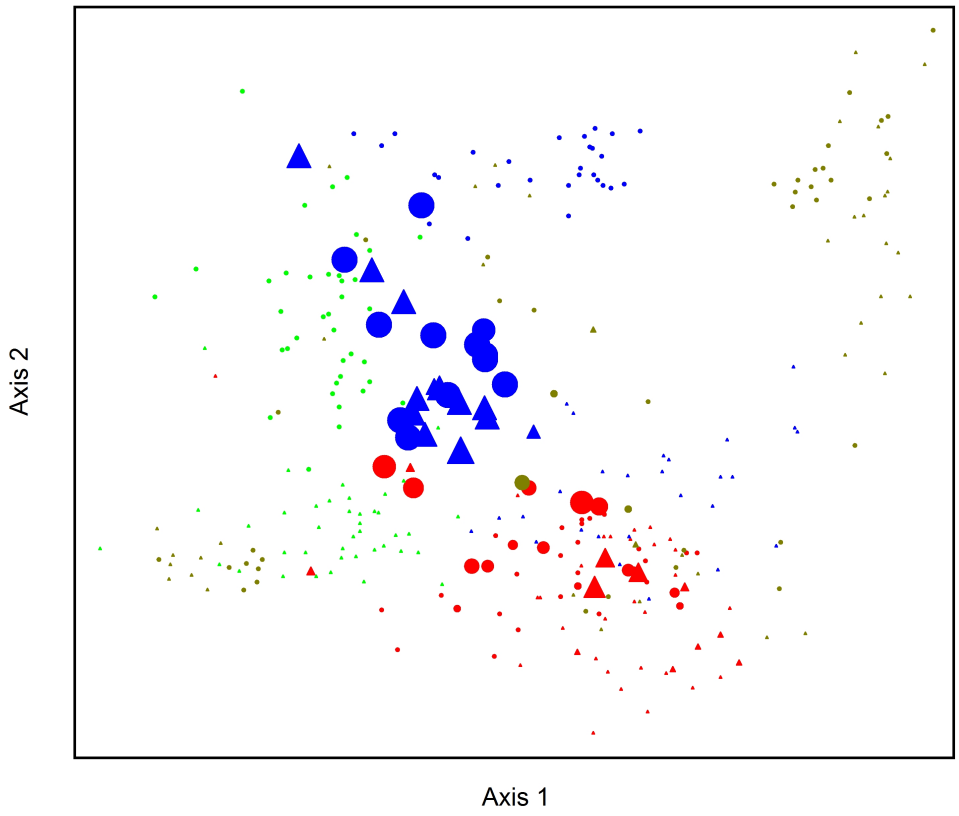
(f) *Ilex aquifolium*



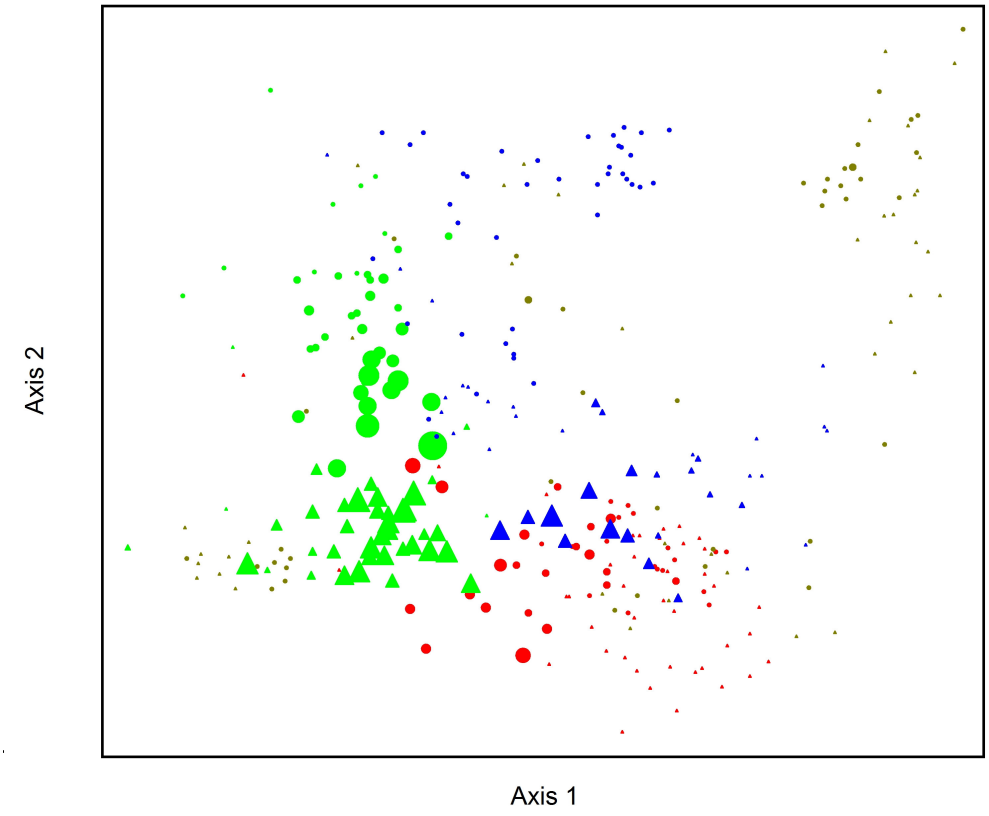
(g) *Juncus effusus*



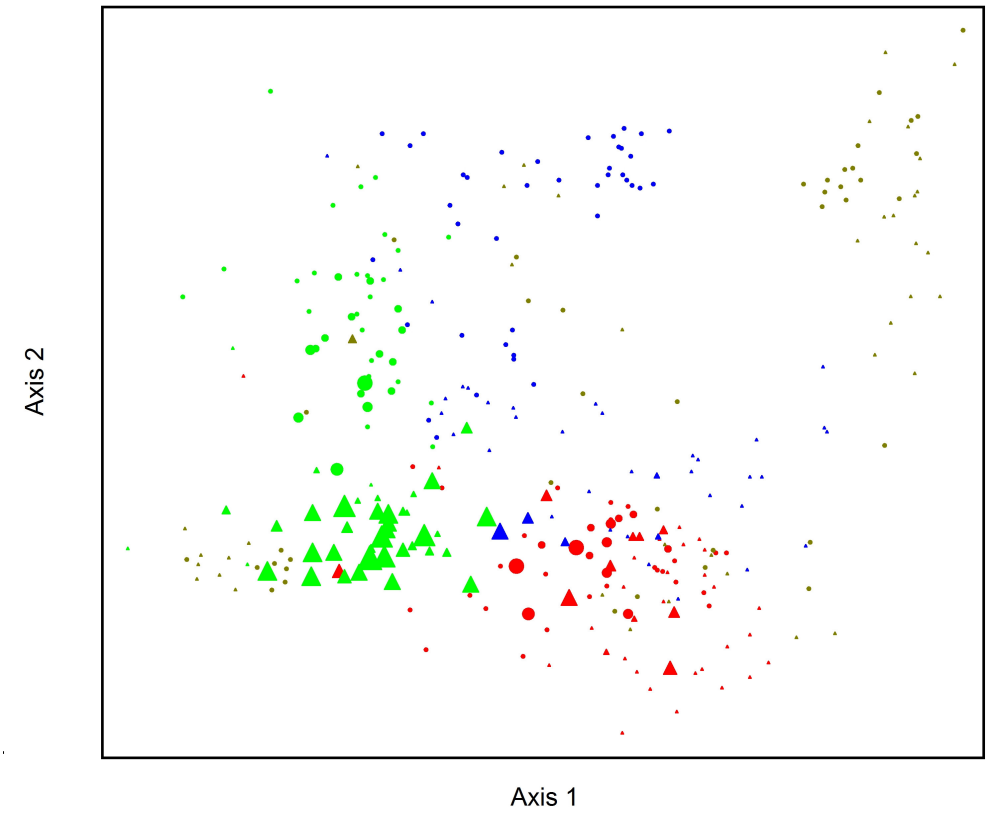
(h) Quercus petraea



(i) *Rubus fruticosus* agg.



(j) Salix cinerea



(k) Ulex europaeus

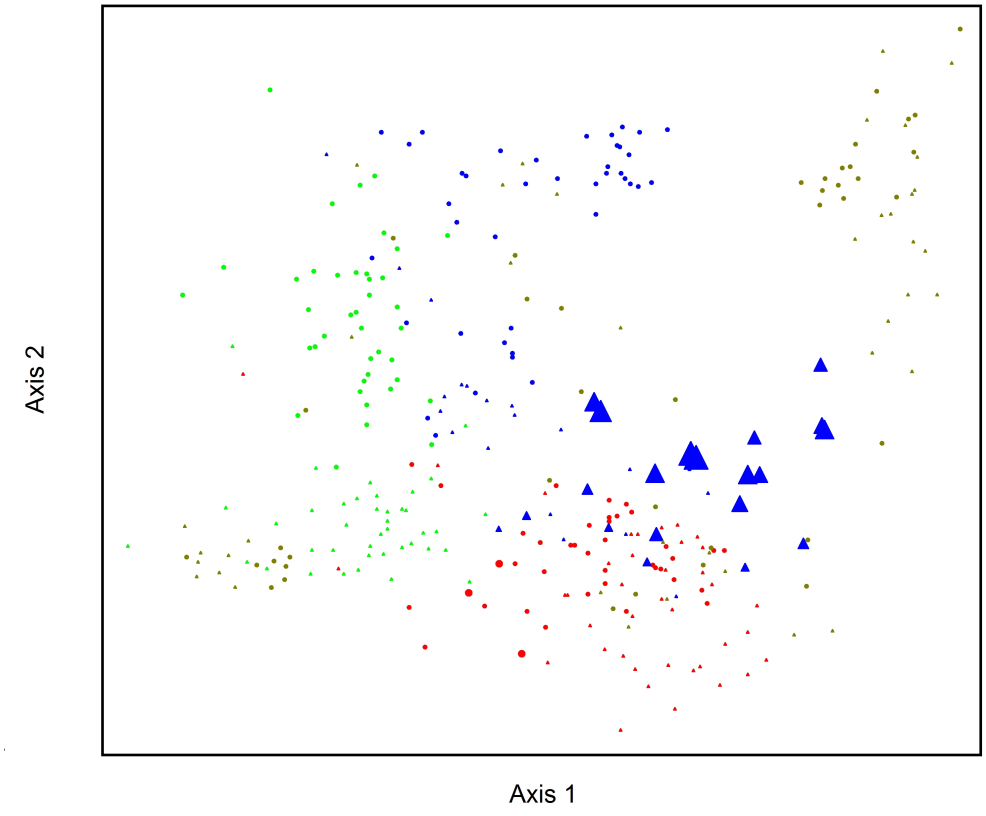
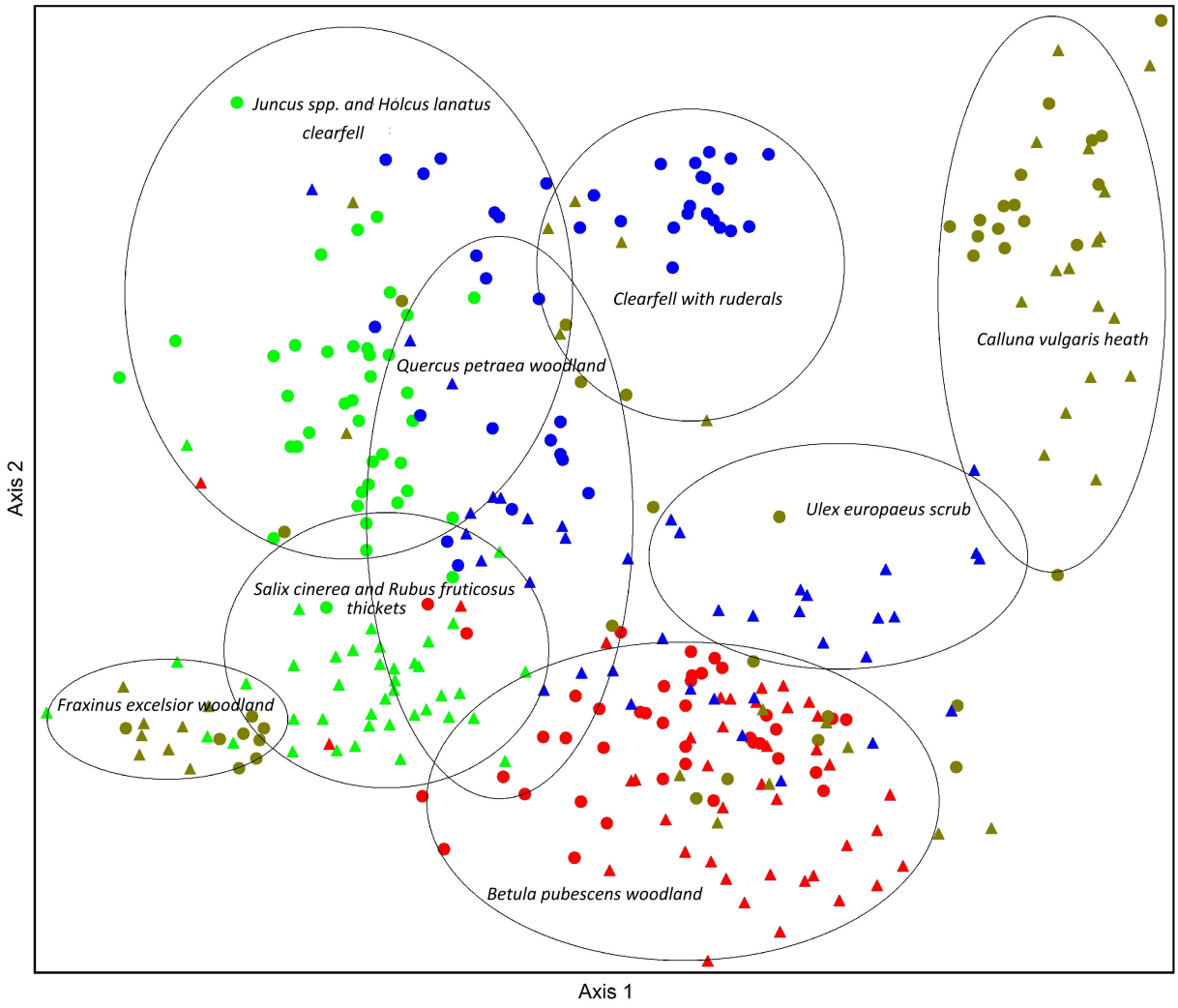


Figure 4 *NMS ordination with indication of vegetation communities. Circles indicate 2003 data, triangles indicate 2009 data. Cullentra plots are in gold, Coill an Fhaltaigh plots are in green, Ballygannon plots are in red and Rosturra plots are in blue.*



3.4 Species diversity

There were significant differences in species diversity between 2003 and 2009 for the majority of comparisons made (Table 7; Appendix 2). At Coill an Fhaltaigh, decreases (i.e., loss of diversity) occurred in all three diversity measures of all plant species, vascular species only and bryophytes only. This is largely due to the loss of ruderals and small stature herbs as bramble and grey willow have become dominant. At Rosturra, a similar pattern of declining diversity occurs, although species richness of bryophytes was marginally higher here in 2009. At Ballygannon, species richness increased for all three groupings of plants, but conversely both Shannon's and Simpson's indices declined. At Cullentra, there was no significant change in the mean number of vascular species, but a considerable increase in the richness of bryophytes recorded.

By comparing between sites, it can be seen that Coill an Fhaltaigh and Rosturra remain the most diverse sites in terms of vascular plant richness, despite their losses. Cullentra and Ballygannon are now more diverse in terms of bryophyte species.

3.5 Carabid beetle communities

A summary of the carabid beetle community structure in 2003 and 2009 is presented in Table 8, Appendix 2.

Cullentra

The overall structure of the carabid community at Cullentra is fairly similar to that in 2003. Abax parallelopepidus is the strong dominant species and was found to be more abundant still in 2009 (82.7% of specimens). Of the other species frequent in 2003, *Pterostichus madidus* and *P. melanarius* are still quite common, but *Pterostichus niger* and *Nebria brevicollis* were not recorded in the 2009. This site and Ballygannon were found to be lower in diversity overall than Coill an Fhaltaigh and Rosturra.

Coill an Fhaltaigh

Abax parallelopepidus was again an abundant species at this site (37.4% of specimens). In 2003 it was most abundant in bramble patches and the increase in this habitat may be important. Due to the wet nature of the site, several hygrophilous species were recorded. One of these, *Platynus obscurus,* was especially abundant within the dense rush areas in 2003, and despite the decline it this habitat has increased markedly in abundance. Another

species of damper habitats, the bronze *Carabus granulatus*, was a strong component in all the communities at this site in 2003 (17.5% of specimens) but has declined sharply (4.8% of specimens in 2009). The proportions of *Pterostichus madidus*, *Pterostichus niger* and *Pterostichus melanarius* are also down. *Chlaenius nigricornis*, a species noted as scarce in Ireland by Anderson *et al.* (2000), was recorded in 2003 at low abundance but was not found in material examined in 2009.

Ballygannon

The black beetle *Abax parallelopepidus* was again by far the most abundant species at this site and has apparently increased in abundance, accounting for over 90% all specimens. Other species frequent in 2003, *Pterostichus melanarius* and *Nebria brevicollis* have declined. Overall richness and diversity in the carabid population at this site is lower than in 2003.

Rosturra

The most abundant beetle overall in 2003 was *Carabus granulatus* (31.9% of specimens) which was found in large numbers in the clearfell areas, particularly amongst the windrows, but was much less abundant in the woodland. This species has declined sharply as the habitat has scrubbed over (3.1% of specimens in 2009). *Abax parallelopepidus* was abundant in all vegetation types in 2003 and has increased its proportion of the community. In 2003, *Pterostichus melanarius* and *Pterostichus nigrita* agg. were more abundant in the woodland, whilst *Pterostichus niger* was most abundant in the dense rush area; only *P.melanarius* has maintained its relative abundance. *Agonum fuliginosum / A. thoreyi* was scarcely recorded in 2003 but was found to be locally very abundant on the windrows in 2009 The scarce species *Chlaenius nigricornis* was also recorded at this site in 2003 but not in 2009.

3.6 Photographic survey

Examples of the change (and lack of change) in vegetation along the relevés is presented in Appendix 3. The significant change in the open clearfells is quite apparent (e.g. Plates 11 and 12), as is the lack of succession at Cullentra (Plates 3 and 4). Photographs from 2003 proved exceptionally useful at relocating plots at some sites.

4. DISCUSSION

4.1 Difficulties encountered

The main difficulty encountered was the relocation of plots in dense vegetation at Coill an Fhaltaigh and Rosturra that lacked plot diagrams from 2003 due to the absence of mature trees. GPS fixes proved of limited use due to the scale of error compared with the distance between plots (i.e. 5 m). However, a combination of compass bearings and the fixed-point photographs was utilised successfully and it is felt that transects were relocated with good accuracy at these sites. Another difficulty posed by the dense vegetation was recording of small stature species such as bryophytes that were hard to search for in plots supporting over 80% cover of bramble and dog rose. Diversity in these thickets is very low, however, and it is unlikely that significant numbers of species were missed. A final issue, again concerned with the dense vegetation, is that surveyors inevitably made a certain degree of impact on the vegetation along the transect simply through relocating and surveying the plots; it is hoped that, given the proposed time between monitoring events, these impacts will be of limited consequence.

4.2 Fossitt habitats

In 2003, the vegetation communities surveyed were classified using Fossitt (2000) and predictions made for future changes. At Cullentra, the limestone woodland corresponded with WN2 oak-ash-hazel woodland (roughly analogous with the Corylo-Fraxinetum association of Braun-Blanquet & Tüxen 1952) and the small birch woodland corresponded with WN1 oak-birch-holly woodland (roughly analogous with the Blechno-Quercetum association), although there is relatively little oak. These areas have not changed. The small area of recent clearfell unsurprisingly was classified as WS5 recently-felled woodland and the heath area was classified as HH3 wet heath, although there is relatively little cross-leaved heath. There has been such little regeneration at this site that we deem the classification of both areas to have remained unchanged. Given the nature of the soil, one would suggest that both of these clearfell areas would, in the absence of management, eventually succeed towards WN1 woodland.

By 2003, the transect at Coill an Fhaltaigh had already re-vegetated rather too much to be classified as WS5 recently-felled woodland. Most of the site was deemed to have characteristics of GS4 wet grassland. It was predicted from the species that were currently

regenerating that the site was developing towards either WN4 wet pedunculate oak-ash woodland or WN6 wet willow-alder-ash woodland. This would appear to be the case, although currently substantial areas of the site are WS1 scrub.

The Ballygannon vegetation communities still all largely represent young examples of WN1 oak-birch-holly woodland, although the wetter areas might be regarded as intermediate between this and WN6 wet willow-alder-ash woodland. The mature woodland at Rosturra remains a good example of the WN1 oak-birch-holly category. The clearfell here was classified as WS5 recently-felled woodland and it was suggested that it would develop towards WN1 and/or WN6 woodland. This would appear to be correct, although several areas are still WS1 scrub.

4.3 Recommendations and future work

The survey and analysis have highlighted several areas for future work and ways to improve the dataset. Careful scrutiny of the data may highlight discrepancies between the two years which will need reconciling. Potential errors include differences in species identification (e.g. *Betula pubescens* and *B. pendula; Agonum thoreyi* and *A. fuliginosum*) and small discrepancies in plot placement that may impact on tree data. These errors are certainly minor compared to the scale of the dataset but it would be helpful to resolve them before any future survey. Another issue is that the sizeable increase in bryophyte richness at Cullentra suggests that this taxon was under-recorded in 2003; it is hoped that re-examination of material collecting in 2003 will yield more species. Lastly, it is possible that vernal species were under-recorded in the limestone woodland at Cullentra due to time of survey. A revisit of the site in spring 2010 would ascertain whether increased grazing or time of survey is responsible for an apparent decline.

It is recommended that another resurvey is conducted in 6 years time. Even spacing of monitoring events will allow the pace of change to be better assessed. It is also strongly recommended that the management issues highlighted in this report are addressed. Heavy grazing at Cullentra is not just limited to area of the transect and deer are severely damaging the existing woodland areas. The deer fencing at this site is proving singularly ineffective at excluding large herbivores. A policy on management of non-native species, both conifers and broadleafs, needs to be agreed upon for these conservation areas. Effective removal of non-

natives is likely to be very difficult in the foreseeable future at Coill an Fhaltaigh and Rosturra where the vegetation is so dense.

Dissemination of results will be an important factor in maintaining the momentum for this project and ensuring funding for future monitoring. To this end it is intended, following further analysis of the data, to publish results in a peer-reviewed journal and deliver presentations to interested groups in Ireland.

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APPENDIX 1: TREE PLOT DIAGRAMS

A diagram of each plot is presented here recording the position, dbh and species of adult trees. Dots represent trees. Figures indicate dbh in cm, with slashes denoting separate stems of multi-stemmed individuals. Other features that may assist in relocating the plot are shown. The top of the diagram is the side of the plot towards plot 40. Letters indicate tree species as follows.

Ap = *Acer pseudoplatanus*

Ag = *Alnus glutinosa*

Bp = *Betula pubescens**

Bpen = *Betula pendula*

Ca = *Corylus avellana*

Claw = *Chamaecyparis lawsoniana*

Ee = *Euonymus europaeus*

Fx = *Fraxinus excelsior*

Ix = *Ilex aquifolium*

Pabi = *Picea abies*

Psit = *Picea sitchensis*

Psyl = *Pinus sylvestris*

Qp = *Quercus petraea*

Qr = *Quercus robur*

Sn = *Sambucus nigra*

Sc = *Salix cinerea*

Scap = *Salix caprea*

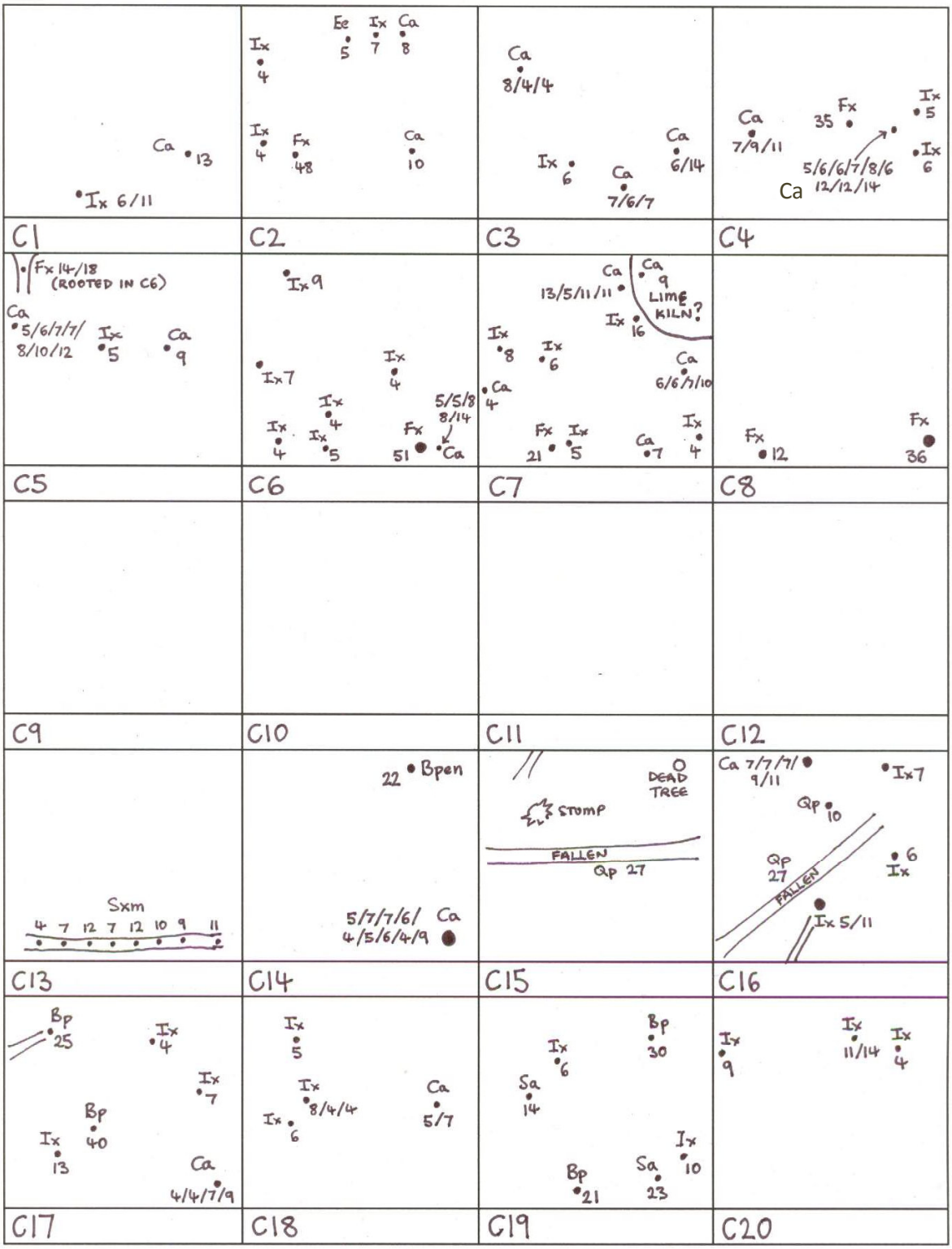
Sxm = *Salix* x *multinervis*

Sa = *Sorbus aucuparia*

Sn = *Sambucus nigra*

*Due to the abundance of *Betula pubescens* at Ballygannon, this species is unlabelled. All other species are labelled.

Cullentra


Ca 13
Ix 6/11
C1
Ee Ix Ca
Ix 5 7 8
4
Ix Fx Ca
4 48 10
C2
Ca
8/4/4
Ix 6
Ca 7/6/7
Ca 6/14
C3
Ca 7/9/11
Fx 35
Ix 5
5/6/6/7/8/6 12/12/14
Ix 6
Ca
C4
Fx 14/18 (ROOTED IN C6)
Ca 5/6/7/7/ 8/10/12
Ix 5
Ca 9
C5
Ix 9
Ix 7
Ix 4
Ix 4
Ix 4
Ix 5
5/5/8 8/14
Fx 51
Ca
C6
Ca 13/5/11/11
Ca 9 LIME KILN?
Ix 16
Ix 8
Ix 6
Ca 6/6/7/10
Ca 4
Fx 21
Ix 5
Ca 7
Ix 4
C7
Fx 12
Fx 36
C8
C9
22 Bpen
5/7/7/6/ Ca
4/5/6/4/9
C10
DEAD TREE
STUMP
FALLEN
Qp 27
C11
Ca 7/7/7/ 9/11
Ix 7
Qp 10
Qp 27
FALLEN
6
Ix
Ix 5/11
C12
Sxm
4 7 12 7 12 10 9 11
C13
Bp 25
Ix 4
Ix 7
Bp 40
Ix 13
Ca 4/4/7/9
C14
Ix 5
Ix 8/4/4
Ix 6
Ca 5/7
C15
Bp 30
Ix 6
Sa 14
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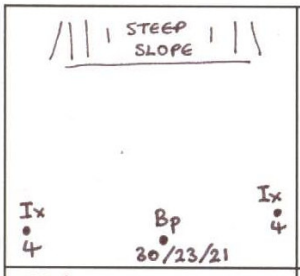
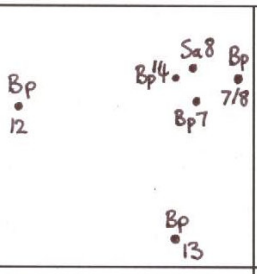
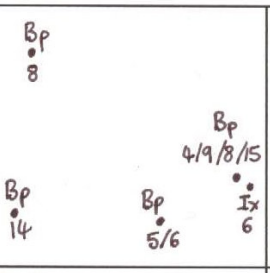
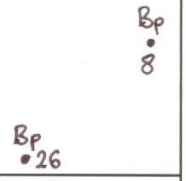
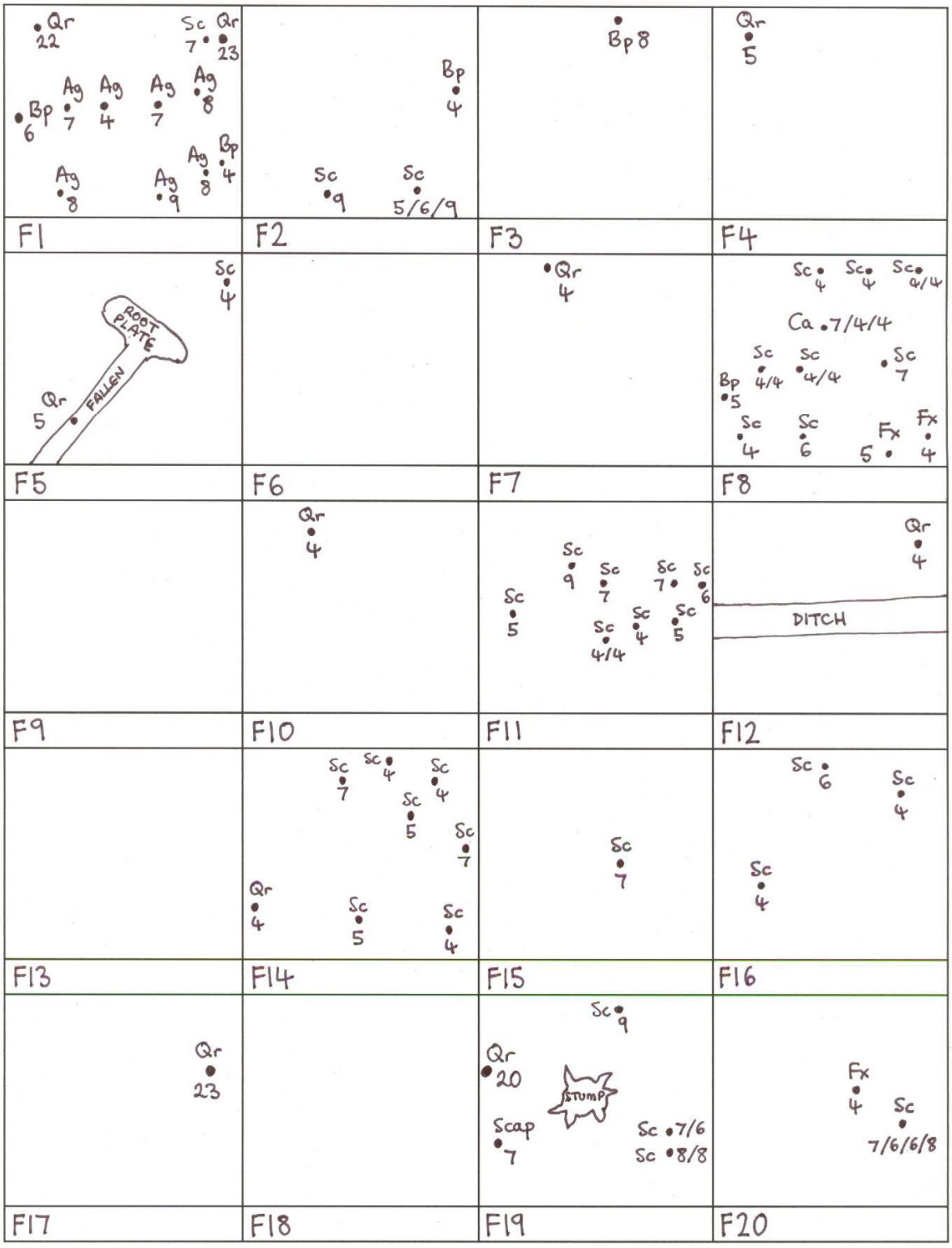
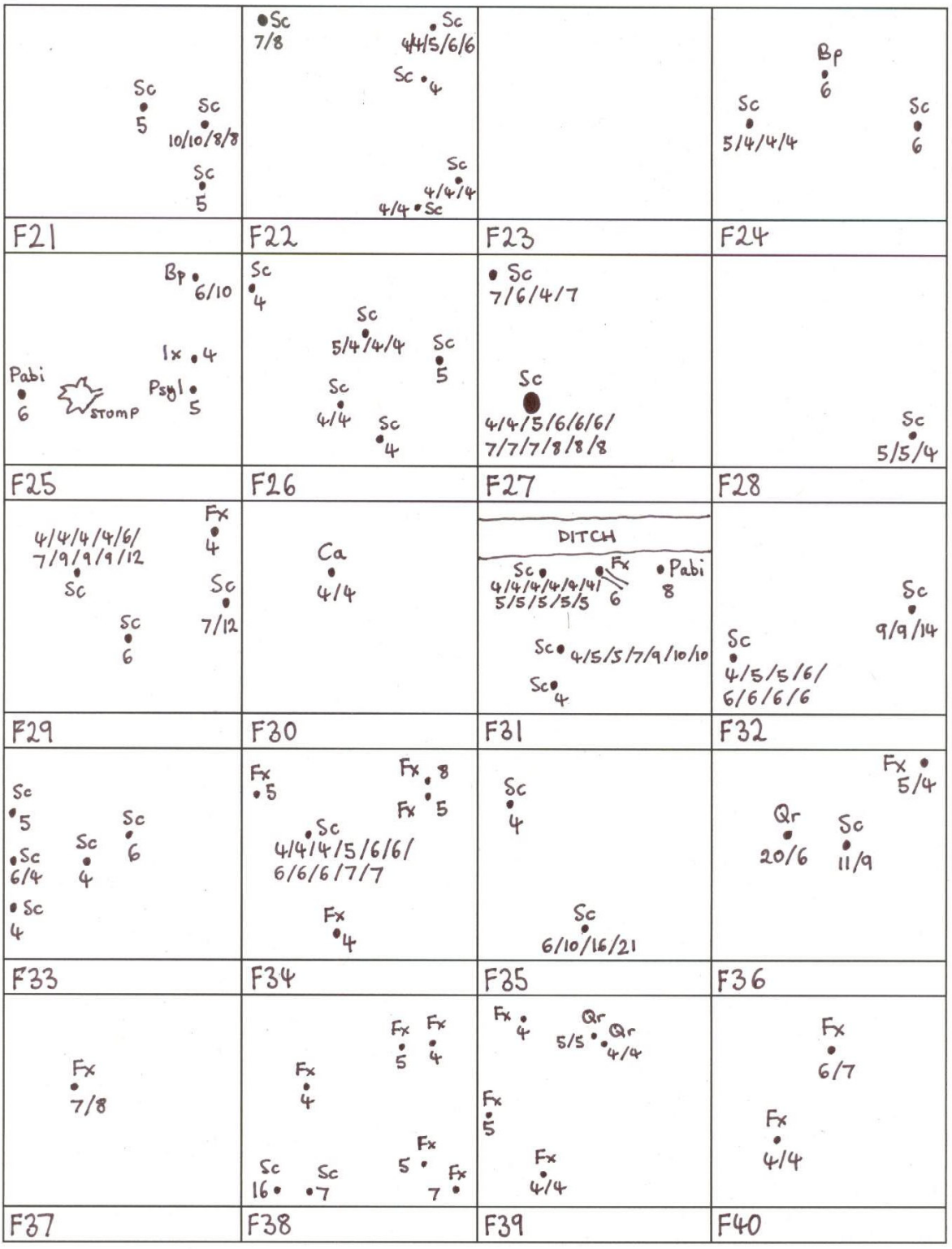
Bp 21
Sa 23
C16
Ix 9
Ix 11/14
Ix 4
C17
C18
C19
C20

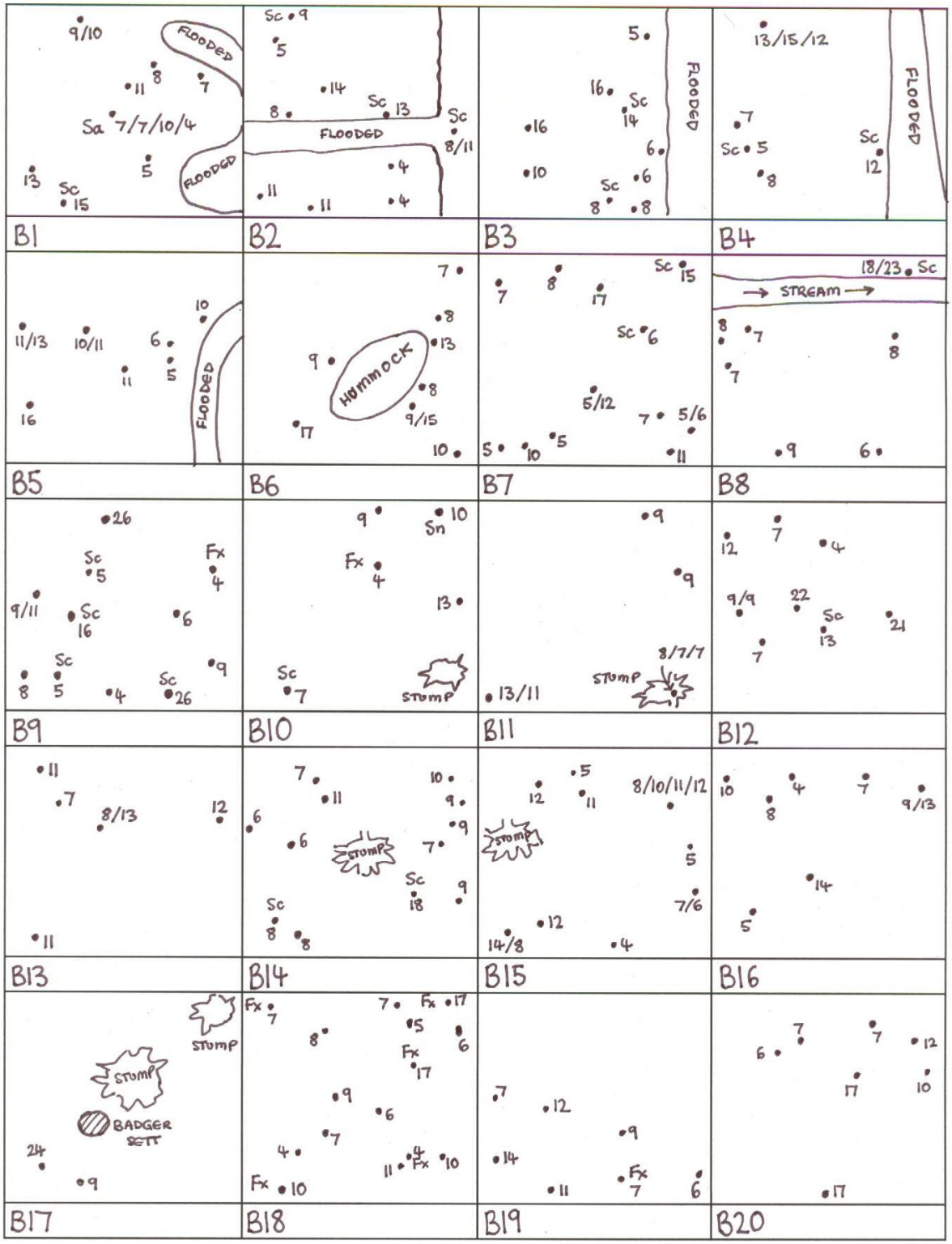
			
C21	C22	C23	C24
C25	C26	C27	C28
C29	C30	C31	C32
			
C33	C34	C35	C36
C37	C38	C39	C40

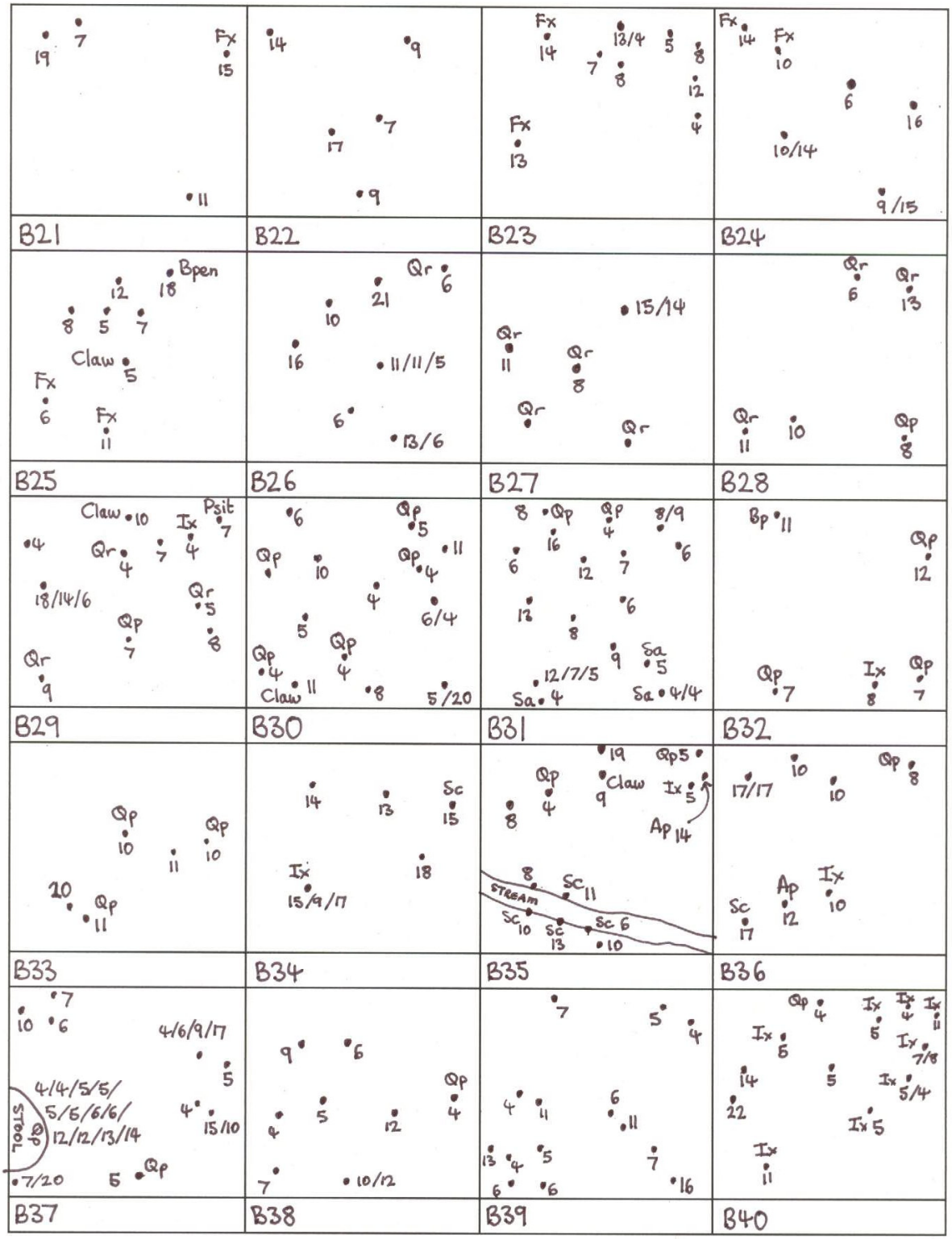
Coill an Fhaltaigh



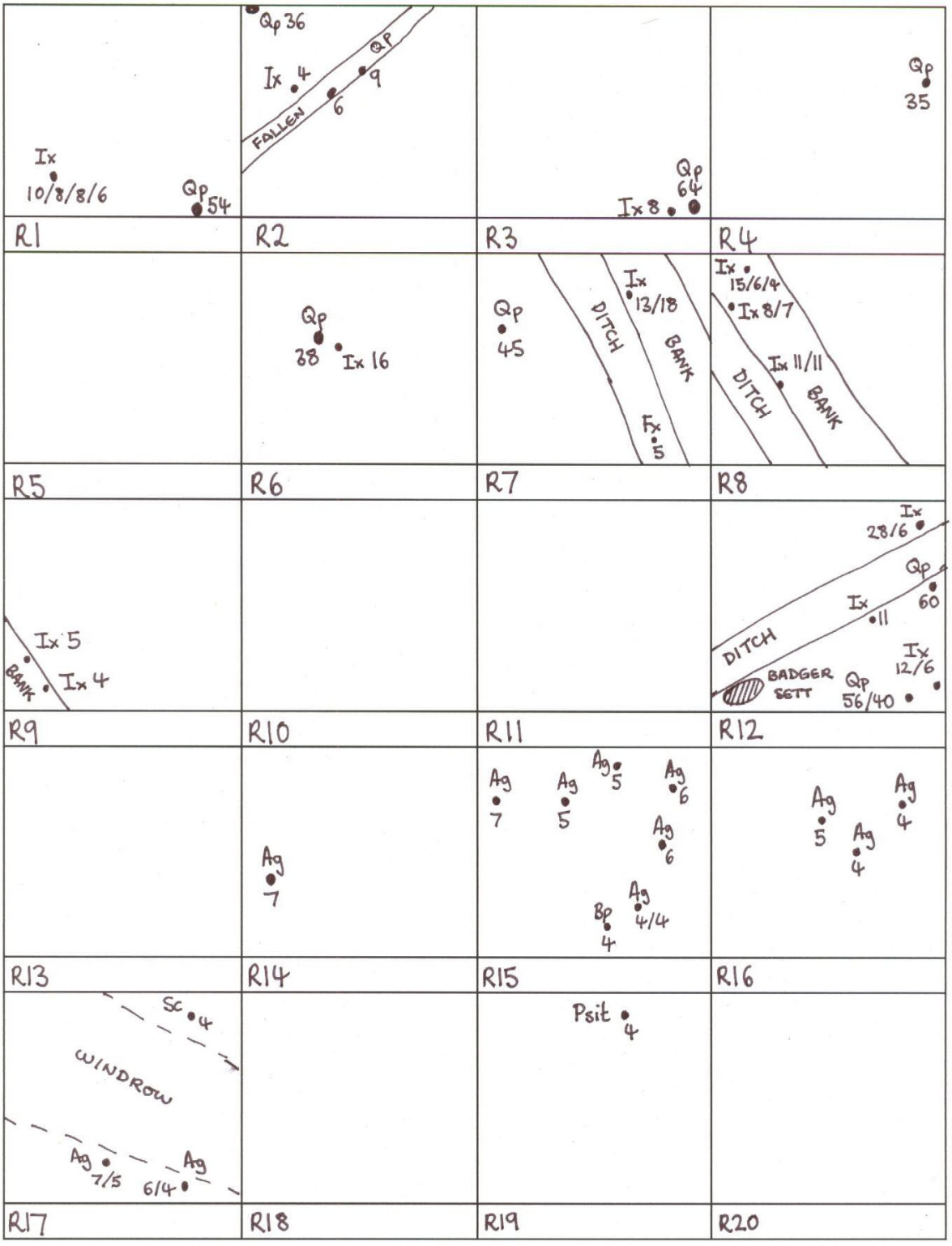

Sc 5
Sc 10/10/8/8
Sc 5
F21
Sc 7/8
Sc 4/4/5/6/6
Sc 4
Sc 4/4/4
4/4 Sc
F22
F23
Bp 6
Sc 5/4/4/4
Sc 6
F24
Bp 6/10
1x 4
Pabi 6
STOMP
Psyl 5
F25
Sc 4
Sc 5/4/4/4
Sc 5
Sc 4/4
Sc 4
Sc 7/6/4/7
Sc 4/4/5/6/6/6/ 7/7/7/8/8/8
F26
F27
Sc 5/5/4
F28
4/4/4/4/6/ 7/9/9/9/12
Sc
Fx 4
Sc 7/12
Sc 6
Ca 4/4
DITCH
Sc 4/4/4/4/4/4/ 5/5/5/5/5/5
Fx 6
Pabi 8
Sc 4/5/5/7/9/10/10
Sc 4
Sc 4/5/5/6/ 6/6/6/6
Sc 9/9/14
F29
F30
F31
F32
Sc 5
Sc 6
Sc 6/4
Sc 4
Sc 4
Fx 5
Fx 8
Fx 5
Sc 4/4/4/5/6/6/ 6/6/6/7/7
Fx 4
Sc 4
Sc 6/10/16/21
Fx 5/4
Qr 20/6
Sc 11/9
F33
F34
F35
F36
Fx 7/8
Fx 5
Fx 4
Fx 4
Sc 16
Sc 7
Fx 5
Fx 7
Fx 4
Qr 5/5
Qr 4/4
Fx 5
Fx 4/4
Fx 6/7
Fx 4/4
F37
F38
F39
F40

Ballygannon




B21
B22
B23
B24
B25
B26
B27
B28
B29
B30
B31
B32
B33
B34
B35
B36
B37
B38
B39
B40
Claw
Bpen
Psit
Fx
Qr
Qp
Ix
Sa
Sc
Ap
Bp
STREAM
TOOLS

Rosturra


Ix 10/8/8/6
Qp 54
R1
Qp 36
Ix 4
Qp
9
6
FALLEN
R2
Qp 64
Ix 8
R3
Qp 35
R4
Qp 38
Ix 16
R5
Qp 45
Ix 13/18
DITCH
BANK
Fx 5
R6
R7
Ix 15/6/4
Ix 8/7
Ix 11/11
DITCH
BANK
R8
Ix 5
BANK
Ix 4
R9
R10
R11
Ix 28/6
Qp 60
Ix 11
DITCH
Ix 12/6
BADGER SETT
Qp 56/40
R12
Ag 7
R13
Ag 7
Ag 5
Ag 5
Ag 6
Ag 6
Bp 4
Ag 4/4
R14
R15
Ag 5
Ag 4
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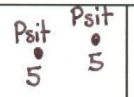
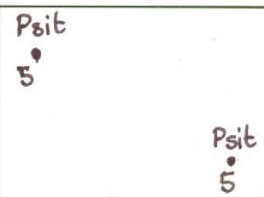
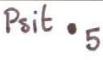
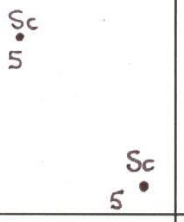
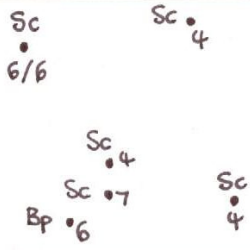
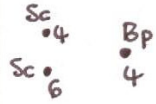
R16
Sc 4
WINDROW
Ag 7/5
Ag 6/4
R17
Psit 4
R18
R19
R20

			
R21	R22	R23	R24
			
R25	R26	R27	R28
			
R29	R30	R31	R32
R33	R34	R35	R36
			
R37	R38	R39	R40

APPENDIX 2: SUMMARY DATA TABLES

Table 1 *Seedling density data. Values are mean number per 25 m^2 ± standard error.*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Alnus glutinosa	-	-	-	-	-	-	1.30 ± 0.39	0.03 ± 0.03
Betula pubescens	7.50 ± 2.08	5.73 ± 1.38	-	0.05 ± 0.03	-	0.40 ± 0.16	25.10 ± 4.87	2.70 ± 0.94
Corylus avellana	-	0.05 ± 0.04	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.03 ± 0.03	0.05 ± 0.03
Crataegus monogyna	0.08 ± 0.06	0.10 ± 0.05	0.03 ± 0.03	0.03 ± 0.03	-	0.03 ± 0.03	-	0.08 ± 0.08
Fraxinus excelsior	5.00 ± 1.90	0.33 ± 0.19	0.55 ± 0.18	0.83 ± 0.61	0.05 ± 0.04	2.43 ± 0.91	0.25 ±0.13	3.58 ± 1.71
Ilex aquifolium	0.68 ± 0.23	4.63 ± 1.27	0.18 ± 0.12	0.03 ± 0.03	1.10 ± 0.30	2.30 ± 0.43	1.85 ± 0.66	3.70 ± 1.90
Quercus petraea	-	0.05 ±0.04	-	-	0.05 ± 0.04	0.15 ± 0.06	0.53 ± 0.13	1.08 ± 0.30
Quercus robur	-		0.28 ± 0.10	0.15 ± 0.06	-		-	-
Salix caprea	-	-	0.05 ± 0.05	-	-	-	-	-
Salix cinerea	0.08 ± 0.06	-	0.55 ± 0.31	-	-	-	12.20 ± 3.89	0.53 ± 0.19
Sorbus aucuparia	0.45 ± 0.16	0.56 ± 0.20	-	-	-	0.10 ± 0.10	0.05 ± 0.04	0.18 ± 0.07
Acer pseudoplatanus	-	-	-	-	-	0.03 ± 0.03	-	-
Fagus sylvatica	-	-	-	-	-	0.03 ± 0.03	-	-
Picea abies	-	-	0.05 ± 0.04	-	-	-	0.57 ± 0.15	-
Picea sitchensis	1.18 ± 0.60	0.23 ± 0.08	-	-	-	-	-	-
Pinus contorta	0.25 ± 0.16	-	-	-	-	-	-	-

Table 2 *Sapling density data. Values are mean number per 25 m^2 ± standard error.*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Alnus glutinosa	-	-	0.13 ± 0.13	-	-	-	1.10 ± 0.38	1.23 ± 0.48
Betula pubescens	1.33 ± 0.36	2.95 ± 0.67	0.20 ± 0.09	0.13 ± 0.07	2.28 ± 0.45	0.08 ± 0.04	0.10 ± 0.06	34.50 ± 5.04
Corylus avellana	-	0.03 ± 0.03	0.38 ± 0.16	0.23 ± 0.13	-	-	0.03 ± 0.03	0.10 ± 0.05
Crataegus monogyna	0.05 ± 0.04	0.03 ± 0.03	0.48 ± 0.15	0.60 ± 0.14	0.03 ± 0.03	-	0.03 ± 0.03	-
Fraxinus excelsior	-	-	4.33 ± 1.31	6.93 ± 3.03	0.10 ± 0.06	0.05 ± 0.05	-	0.03 ± 0.03
Ilex aquifolium	0.68 ± 0.20	0.30 ± 0.09	0.05 ± 0.04	0.03 ± 0.03	0.65 ± 0.17	0.53 ± 0.17	0.68 ± 0.39	0.70 ± 0.45
Malus sylvestris	-	-	-	0.13 ± 0.13	-	-	-	
Prunus spinosa	-	-	0.03 ± 0.03	0.05 ± 0.03	-	-	-	-
Quercus petraea	-	-	-	-	0.60 ± 0.20	0.15 ± 0.08	-	0.08 ± 0.04
Quercus robur	-	-	0.60 ± 0.16	1.73 ± 0.27	-	-	-	-
Salix caprea	-	-	0.10 ± 0.05	0.10 ± 0.06	-	-	-	0.03 ± 0.03
Salix cinerea	-	-	7.35 ± 1.25	8.08 ± 1.73	0.13 ± 0.06	-	0.15 ± 0.08	7.23 ± 1.83
Sorbus aucuparia	0.18 ± 0.15	0.05 ± 0.03	-	-	-	-	-	0.03 ± 0.03
Salix x multinervis	-	-	0.08 ± 0.04	0.43 ± 0.29	-	-	-	0.68 ± 0.15
Salix x reichardtii	-	-	-	0.05 ± 0.03		-	-	-
Viburnum opulus	-	-	0.55 ± 0.39	0.40 ± 0.23	-	-	-	-
Abies procera	-	-	-	-	0.10 ± 0.07	-	-	-
Acer pseudoplatanus	-	-	0.05 ± 0.04	0.08 ± 0.04	-	-	-	-
Chamaecyparis lawsoniana	-	-	-	-	-	0.08 ± 0.06	-	-
Fagus sylvatica	-	-	0.02 ± 0.02	0.03 ± 0.03	-	-	-	-
Larix kaempferi	0.13 ± 0.06	0.03 ± 0.03	-	-	-	-	-	-
Picea abies	-	-	0.13 ± 0.08	0.08 ± 0.06	-	-	-	-
Picea sitchensis	0.38 ± 0.14	0.23 ± 0.10	-	-	-	-	-	0.58 ± 0.13
Pinus contorta	0.53 ± 0.22	-	-	-	-	-	-	-
Pinus sylvestris	-	0.05 ± 0.03	0.03 ± 0.03	-	-	-	-	-
Thuja plicata	-	-	-	-	0.08 ± 0.04	-	-	-
Tsuga heterophylla	-	0.03 ± 0.03	-	-	-	-	-	

Table 3 *Sapling height data. Values are mean height (cm) ± standard error*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Alnus glutinosa	-		101.40 ± 8.12	-	-	-	68.52 ± 2.05	292.51 ± 12.97
Betula pubescens	79.43 ± 3.31	113.21 ± 4.25	124.13 ± 13.93	149.60 ± 26.23	528.57 ± 13.76	666.67 ± 88.19	76.25 ± 6.88	201.61 ± 2.39
Corylus avellana	-	160.00	128.00 ± 11.76	286.67 ± 40.10	-	-	310.00	175.00 ± 48.39
Crataegus monogyna	132.50 ± 2.50	130.00	111.47 ± 12.13	227.08 ± 23.12	190.00	-	220.00	-
Fraxinus excelsior	-		154.80 ± 5.83	286.26 ± 9.11	320.00 ± 70.59	400.00 ± 100.00	-	75.00
Ilex aquifolium	228.15 ± 13.18	179.54 ± 25.03	105.00 ± 45.00	90.00	156.35 ± 22.28	154.14 ± 19.55	93.70 ± 7.03	85.14 ± 5.97
Malus sylvestris			-	296.00 ± 55.91	-	-		
Prunus spinosa	-		100.00	190.00 ± 70.00	-		-	-
Quercus petraea	-		-	-	358.33 ± 21.63	355.00 ± 27.17	-	113.00 ± 53.56
Quercus robur	-		103.13 ± 6.92	222.25 ± 11.44	-	-	-	
Salix caprea	-		121.25 ± 20.85	450.00 ± 35.36	-	-	-	150.00
Salix cinerea	-		163.47 ± 4.63	315.22 ± 6.70	560.00 ± 57.88	-	62.67 ± 3.62	190.57 ± 5.83
Salix x multinervis	-		90.00 ± 15.28	267.65 ± 21.67	-	-	-	201.48 ± 17.08
Salix x reichardtii				375.00 ± 25.00	-	-		
Sorbus aucuparia	98.57 ± 33.78	194.00 ± 106.00	-	-	-	-	-	90.00
Viburnum opulus	-		122.73 ± 6.49	210.63 ± 16.67	-	-	-	-
Abies procera	-		-	-	83.75 ± 12.81	-	-	-
Acer pseudoplatanus	-		97.50 ± 32.50	270.00 ± 47.26	-	-	-	-
Chamaecyparis lawsoniana					-	140.00 ± 80.00		
Fagus sylvatica	-		100.00	300.00	-	-	-	-
Larix kaempferi	90.00 ± 11.40	100.00	-	-	-	-	-	-
Picea abies	-		88.00 ± 16.55	220.00 ± 30.55	-	-	-	-
Picea sitchensis	80.67 ± 5.21	99.00 ± 10.04	-	-	-	-	-	213.04 ± 23.84
Pinus contorta	87.62 ± 4.41		-	-	-	-	-	-
Pinus sylvestris	-	88.00 ± 12.00	70.00	-	-	-	-	-
Thuja plicata	-	-	-	-	150.00 ± 46.19	-	-	-
Tsuga heterophylla	-	175.00	-	-	-	-	-	-

Table 4 *Tree density data. Values are mean number of individual trees per 25 m^2 ± standard error.*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Alnus glutinosa	-	-	-	0.18 ± 0.18	-	-	-	0.30 ± 0.17
Betula pendula	-	0.03 ± 0.03	-	-	-	0.03 ± 0.03	-	-
Betula pubescens	0.45 ± 0.18	0.45 ± 0.18	-	0.18 ± 0.07	7.73 ± 0.73	5.75 ± 0.48	-	0.18 ± 0.08
Corylus avellana	0.60 ± 0.17	0.50 ± 0.16	-	0.05 ± 0.03	-	-	-	-
Euonymus europaeus	0.03 ± 0.03	0.03 ± 0.03	-	-	-	-	-	-
Fraxinus excelsior	0.20 ± 0.09	0.18 ± 0.08	-	0.53 ± 0.18	0.30 ± 0.13	0.38 ± 0.15	0.03 ± 0.03	0.03 ± 0.03
Ilex aquifolium	0.73 ± 0.21	0.90 ± 0.24	-	0.03 ± 0.03	0.18 ± 0.13	0.33 ± 0.20	0.28 ± 0.11	0.33 ± 0.12
Quercus petraea	0.05 ± 0.04	0.08 ± 0.06	-	-	0.70 ± 0.22	0.58 ± 0.19	0.25 ± 0.10	0.20 ± 0.07
Quercus robur	-	-	0.15 ± 0.07	0.28 ± 0.08	-	0.28 ± 0.14	-	-
Salix caprea	-	-	-	0.03 ± 0.03	-	-	-	-
Salix cinerea	0.03 ± 0.03	-	0.08 ± 0.06	1.83 ± 0.35	0.65 ± 0.18	0.70 ± 0.18	-	0.25 ± 0.14
Salix x *multinervis*	0.08 ± 0.06	0.03 ± 0..03	-	-	-	-	-	-
Sambucus nigra	-	-	-	-	0.03 ± 0.03	0.03 ± 0.03	-	-
Sorbus aucuparia	0.13 ± 0.06	0.08 ± 0.06	-	-	0.10 ± 0.10	0.03 ± 0.03	-	-
Acer pseudoplatanus	-	-	-	-	0.03 ± 0.03	0.05 ± 0.03	-	-
Chamaecyparis lawsoniana	-	-		-	-	0.10 ± 0.05	-	
Picea abies	-	-	-	0.05 ± 0.03	-	-	-	-
Picea sitchensis	-	-	-	-	-	0.03 ± 0.03	-	0.23 ± 0.09
Pinus sylvestris	-	-	-	0.03 ± 0.03	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	0.03 ± 0.03	-	-	-
Thuja plicata	-	-	-	-	0.08 ± 0.04	-	-	-

Table 5 *Tree diameter data. Values are mean dbh for individual stems ± standard error.*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Alnus glutinosa	-	-	-	7.29 ± 0.61	-	-	-	5.27 ± 0.30
Betula pendula	-	22.00	-	-	-	17.52		
Betula pubescens	13.43 ± 1.49	14.59 ± 1.95	-	6.13 ± 0.72	7.28 ± 0.16	9.59 ± 0.26	-	5.29 ± 0.71
Corylus avellana	7.44 ± 0.33	7.69 ± 0.34	-	4.60 ± 0.60	-	-	-	-
Euonymus europaeus	3.5 ± 0.32	5.00	-	-	-	-	-	
Fraxinus excelsior	22.12 ± 4.07	29.38 ± 5.39	-	5.08 ± 0.26	6.92 ± 0.57	10.23 ± 1.22	4.14	5.00
Ilex aquifolium	6.33 ± 0.54	6.68 ± 0.47	-	4.00	8.21 ± 0.93	8.03 ± 0.93	9.90 ± 1.22	9.78 ± 1.16
Quercus petraea	14.64 ± 7.64	21.33 ± 5.67	-	-	6.91 ± 0.45	6.89 ± 0.53	39.62 ± 5.58	47.56 ± 3.70
Quercus robur	-	-	16.18 ± 1.18	11.67 ± 2.55	-	8.80 ± 1.26	-	-
Salix caprea	-	-	-	7.00	-	-	-	-
Salix cinerea	7.96	-	7.43 ± 0.87	6.01 ± 0.19	9.01 ± 0.68	11.06 ± 1.00	-	5.00 ± 0.33
Salix x *multinervis*	6.25 ± 0.45	9.00 ± 1.00	-	-	-	-	-	-
Sambucus nigra	-	-	-	-	10.12	10.00	-	-
Sorbus aucuparia	11.84 ± 3.01	15.00 ± 4.36	-	-	4.78 ± 1.37	7.00 ± 1.22	-	-
Acer pseudoplatanus	-	-	-	-	8.28	13.00 ± 1.00	-	-
Chamaecyparis lawsoniana	-	-	-	-	-	8.78 ± 1.21	-	-
Picea abies	-	-	-	7.00 ± 1.00	-	-	-	-
Picea sitchensis	-	-	-	-	-	7.32	-	4.78 ± 0.15
Pinus sylvestris	-	-	-	5.00	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	5.41	-	-	-
Thuja plicata	-	-	-	-	6.26 ± 0.46	-	-	-

Table 6 *Basal area data. Values are mean area (cm^2) per plot ± standard error.*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Alnus glutinosa	-	-	-	7.60 ± 7.60	-	-	-	8.54 ± 4.79
Betula pendula	-	9.50 ± 9.50	-	-	-	6.02 ± 6.02	-	-
Betula pubescens	114.59 ± 49.98	149.48 ± 63.81	-	6.46 ± 3.13	436.67 ± 34.16	586.68 ± 41.40	-	4.26 ± 2.46
Corylus avellana	89.37 ± 31.30	87.71 ± 29.23	-	2.22 ± 1.69	-	-	-	-
Euonymus europaeus	0.49 ± 0.35	0.49 ± 0.49	-	-	-	-	-	-
Fraxinus excelsior	125.35 ± 66.87	167.51 ± 81.98	-	14.02 ± 4.80	12.14 ± 5.81	36.92 ± 17.52	0.34 ± 0.34	0.49 ± 0.49
Ilex aquifolium	29.59 ± 10.19	43.20 ± 13.19	-	0.31 ± 0.31	14.77 ± 10.03	26.11 ± 15.42	51.45 ± 21.37	56.69 ± 29.91
Quercus petraea	10.71 ± 9.77	30.59 ± 21.40	-	-	38.69 ± 16.73	37.93 ± 18.96	535.44 ± 244.25	418.97 ± 191.51
Quercus robur	-	-	31.66 ± 16.01	48.93 ± 24.38	-	20.15 ± 12.13	-	-
Salix caprea	-	-	-	0.96 ± 0.96	-	-	-	-
Salix cinerea	1.24 ± 1.24	-	3.34 ± 2.35	142.65 ± 29.04	62.25 ± 19.16	96.29 ± 28.76	-	5.64 ± 3.56
Salix x multinervis	6.36 ± 5.73	13. 82 ± 13.82	-	-	-	-	-	-
Sambucus nigra	-	-	-	-	0.40 ± 0.40	1.96 ± 1.96	-	-
Sorbus aucuparia	17.32 ± 12.98	15. 49 ± 14.26	-	-	2.97 ± 2.22	4.20 ± 4.20	-	-
Acer pseudoplatanus	-	-	-	-	1.34 ± 1.35	6.68 ± 4.72	-	-
Chamaecyparis lawsoniana	-	-	-	-	-	6.40 ± 3.36	-	-
Picea abies	-	-	-	1.96 ± 1.43	-	-	-	-
Picea sitchensis	-	-	-	-	-	1.05 ± 1.05	-	4.06 ± 1.68
Pinus sylvestris	-	-	-	0.49 ± 0.49	-	-		
Pseudotsuga menziesii	-	-	-	-	0.88 ± 0.88	-	-	-
Thuja plicata	-	-	-	-	2.33 ± 1.34	-	-	-

Table 7 *Species diversity scores for the various taxa. Greyed boxes indicate where median values were* ***not*** *found to be significantly different between years according to a Wilcoxon matched-pairs signed-ranks test (p≥0.05).*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Vascular plants								
Species richness: Mean	12.83 ± 2.58	12.95 ± 4.62	26.13 ± 0.89	20.68 ± 0.83	13.63 ± 0.52	16.45 ± 0.63	21.55 ± 7.16	18.28 ± 6.67
Median	13.00	12.00	26.50	21.00	13.50	17.00	22.00	16.50
Shannon diversity: Mean	1.35 ± 0.08	1.06 ± 0.52	2.52 ± 0.07	1.60 ± 0.05	1.74 ± 0.05	1.59 ± 0.04	2.33 ± 0.09	1.54 ± 0.17
Median	1.51	1.14	2.56	1.61	1.80	1.66	2.49	1.56
Simpson's index: Mean	0.56 ± 0.04	0.49 ± 0.25	0.86 ± 0.02	0.68 ± 0.02	0.74 ± 0.01	0.70 ± 0.01	0.83 ± 0.02	0.67 ± 0.07
Median	0.69	0.59	0.88	0.68	0.76	0.72	0.88	0.68
Bryophytes								
Species richness: Mean	6.23 ± 0.30	18.15 ± 1.12	6.28 ± 0.28	4.43 ± 0.33	8.10 ± 0.36	12.75 ± 0.57	7.48 ± 0.25	9.60 ± 0.60
Median	6.00	17.50	6.00	4.00	8.00	12.50	7.50	8.50
Shannon diversity: Mean	1.43 ± 0.04	1.38 ± 0.10	1.49 ± 0.05	0.67 ± 0.03	1.67 ± 0.06	1.26 ± 0.08	1.60 ± 0.04	1.28 ± 0.06
Median	1.42	1.52	1.49	0.68	1.74	1.16	1.58	1.17
Simpson's index: Mean	0.70 ± 0.02	0.57 ± 0.04	0.71 ± 0.01	0.39 ± 0.02	0.75 ± 0.01	0.54 ± 0.03	0.73 ± 0.02	0.61 ± 0.02
Median	0.72	0.63	0.71	0.43	0.78	0.53	0.75	0.60
All plants								
Species richness: Mean	19.05 ± 0.49	31.10 ± 1.70	32.40 ± 0.97	25.10 ± 0.94	21.73 ± 0.69	29.20 ± 0.84	29.03 ± 1.10	27.88 ± 1.06
Median	19.00	29.00	33.00	25.00	21.50	29.00	29.00	26.00
Shannon diversity: Mean	1.94 ± 0.06	1.70 ± 0.06	2.70 ± 0.06	1.88 ± 0.04	2.08 ± 0.04	1.87 ± 0.05	2.54 ± 0.06	1.91 ± 0.03
Median	2.02	1.70	2.77	1.89	2.11	1.92	2.60	1.92
Simpson's index: Mean	0.74 ± 0.02	0.71 ± 0.02	0.87 ± 0.01	0.76 ± 0.1	0.79 ± 0.01	0.75 ± 0.01	0.85 ± 0.01	0.75 ± 0.01
Median	0.79	0.71	0.90	0.77	0.81	0.78	0.85	0.76

Table 8 *Carabid beetle data. Values are percentages of total community*

	Cullentra		Coill an Fhaltaigh		Ballygannon		Rosturra	
	2003	2009	2003	2009	2003	2009	2003	2009
Abax parallelopepidus	62.1	82.7	25.8	37.4	67.6	91.8	23.5	37.0
Carabus granulatus	1.5	0.0	17.5	4.8	0.9	0.0	31.9	3.1
Pterostichus madidus	8.2	9.1	13.2	2.8	2.3	0.0	9.4	3.9
Pterostichus niger	7.9	0.0	13.1	1.9	2.8	0.0	5.6	2.4
Pterostichus nigrita agg.	2.6	0.7	0.0	0.0	1.8	0.7	3.3	1.6
Platynus obscurus	0.0	0.0	8.2	40.2	0.0	0.0	0.0	0.0
Pterostichus melanarius	10.8	4.2	7.4	1.7	15.3	2.7	11.7	12.6
Nebria brevicollis	5.5	0.0	0.0	0.0	6.1	0.7	8.2	0.0
Trechus obtusus	0.0	0.0	4.2	0.0	1.1	0.0	<0.1	0.0
Agonum thoreyi/ A. fuliginosum	0.0	0.0	3.7	6.5	0.6	0.0	1.1	33.9
Loricera pilicornis	0.2	0.0	<0.1	0.0	0.6	0.7	1.9	3.9
Agonum muelleri	0.0	0.0	0.1	0.9	0.0	0.0	0.8	0.0
Notiophilus biguttatus	0.0	0.0	0.0	0.0	0.0	0.7	0.4	0.0
Carabus nemoralis	<0.1	0.0	0.2	0.0	0.2	0.7	0.0	0.0
Clivina fossor	0.0	0.0	0.3	0.9	<0.1	1.4	<0.1	0.0
Agonum assimile	0.2	0.0	0.0	0.9	<0.1	0.7	0.0	1.6
Bembidion spp.	0.0	0.0	1.5	0.9	0.0	0.0	<0.1	0.0
Other species	1.2	0.0	5.4	0.0	0.9	0.0	2.0	0.0

APPENDIX 3: EXAMPLES OF FIXED-POINT PHOTOGRAPHY

Plate 1 *Cullentra plot 20, 2003. Canopy of birch (*Betula pubescens*) and holly (*Ilex aquifolium*) with a ground flora including hay-scented buckler-fern (*Dryopteris aemula*) and hard fern (*Blechnum spicant*).*

Plate 2 *Cullentra plot 20, 2009. Plot remains very similar, with the same structure and species composition.*

Plate 3 *Cullentra plot 37, 2003. Plot is dominated by heather (*Calluna vulgaris*) with occasional self-seeded Japanese larch (*Larix kaempferi*) and Sitka spruce (*Picea sitchensis*).*

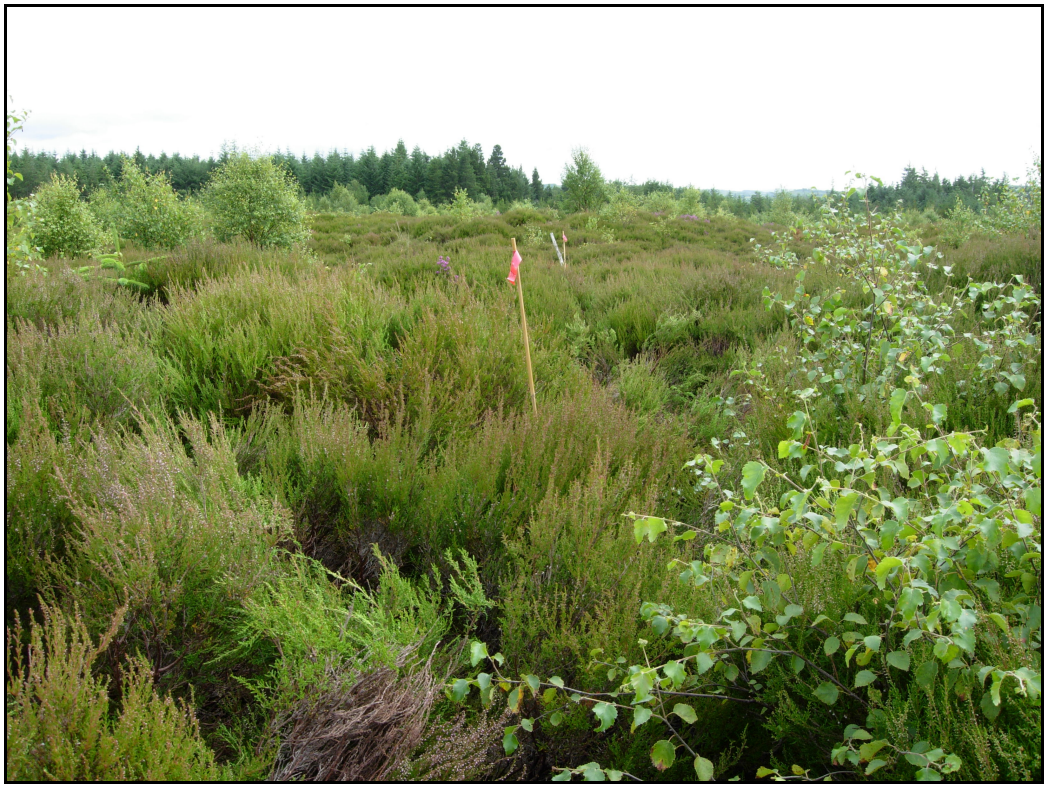


Plate 4 *Cullentra plot 37, 2009. Heather remains the dominant species and can be seen to have grown taller. Japanese larch and Sitka spruce are no longer apparent and there was evidence of these having been cut. Birch saplings have a patchy distribution in this section of the transect.*

Plate 5 *Coill an Fhaltaigh plot 22, 2003. This clearfell area is dominated by bramble (*Rubus fruticosus *agg.), rushes and grasses. This view is typical of the transect.*

Plate 6 *Coill an Fhaltaigh plot 22, 2009. The plot has changed dramatically and is now dominated by bramble and grey willow (*Salix cinerea*). This is also a typical view of the changes which have occurred at the transect.*

Plate 7 *Ballygannon plot 13, 2003. This transect has a well-developed canopy dominated by birch. This view is typical of much of the transect. Tufted hair-grass (*Deschampsia caespitosa*) and bramble are evident in the ground layer.*

Plate 8 *Ballygannon plot 13, 2009. The plot is largely unchanged, with a birch canopy and a grassy field layer. This would remain representative of the transect.*

Plate 9 *Rosturra plot 4 2003. This section of the transect is dominated by a mature sessile oak (*Quercus petraea*) canopy woodland. There is a rich cover of bryophytes on the forest floor and soft rush (*Juncus effusus*) is evident.*

Plate 10 *Rosturra plot 4, 2009. The woodland here remains largely unchanged, though an increase in grasses within the ground flora is apparent. Soft rush remains constant.*

Plate 11 *Rosturra plot 16, 2003. This section of the transect is an open clearfell site with windrows and stumps evident. There is a rich covering of bryophytes and also occasional clumps of rushes and some heather.*

Plate 12 *Rosturra plot 16, 2009. The plot has changed dramatically and is now dominated by birch saplings.*

Plate 13 *Rosturra plot 29 2003. This section of the transect is also open clearfell with abundant rushes and bryophyte cover.*

Plate 14 *Rosturra plot 29 2009. The plot has changed dramatically and is dominated by extensive thickets of dense gorse (*Ulex europaeus*). There are also occasional grey willow (*Salix cinerea*) saplings and self-seeding Sitka spruce (*Picea sitchensis*).*