

Durham Coastal Grasslands Restoration Project

- a preliminary investigation to assess the feasibility of potential future seed transfer



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Background

Herb-rich coastal grasslands were known to be a feature of the Durham coastline north of Crimdon Dene and particularly around the Blackhall area until c.1960 when conversion to arable production took place. These grasslands were also known to support the last remaining populations of green-winged orchid (*Orchis morio*) in County Durham but sadly this species was last recorded in 1954. Thereafter the coastal fields were intensively ploughed almost down to the cliff edges. Many of the coastal fields between Crimdon and Hawthorn Hive were subsequently managed for arable crop production until the 1990's.

Turning The Tide, a partnership project set up in 1997 aimed to regenerate the Durham coastal environment following the collapse of the coal mining industry. The partnership purchased a substantial area of coastal arable grassland with the intention of re-creating herb-rich grassland habitat for nature conservation. A total of 225 hectares of arable land was sown with a neutral grassland wild flower mix, typically containing large quantities of seed from leguminous plant species such as clovers, birdsfoot trefoil and meadow vetchling together with herb species including yellow rattle, wild carrot and common knapweed. The majority of those areas sown have been annually managed by hay-cropping up till the present time.

Introduction

The current *Limestone Landscapes Project* partnership recognises that there is further scope for improving the floristic diversity of the conversion grasslands by a combination of livestock grazing implementation and additional seed transfer from the existing local seed bank. The present study aims to identify those remaining areas of semi-natural grassland where seed collection might be feasible by mechanical and/or manual means and additionally to identify suitable receptor sites for future seed transfer. The study further aims to highlight the suitability of specific grassland plant species relative to grassland locations and to identify key indicator species which may be used in future to monitor the effectiveness of seed transfer.

Soil sampling first carried out in 1999 and again in 2007 has shown that the majority of fields where arable conversion has taken place are now sufficiently depleted of nutrients to allow the successful re-establishment of herb species. Regular annual cropping for hay since 1999 appears to have steadily reduced levels of dissolved phosphorus in the majority of grasslands to below the recognised 10mg/l threshold. Counts of less than 10 mg/l would be expected for semi-natural neutral grasslands. The reduced nutrient status of the soils is further confirmed on the ground where a widespread but slow natural recruitment of herb species from adjacent unimproved semi-natural grassland sites has occurred.

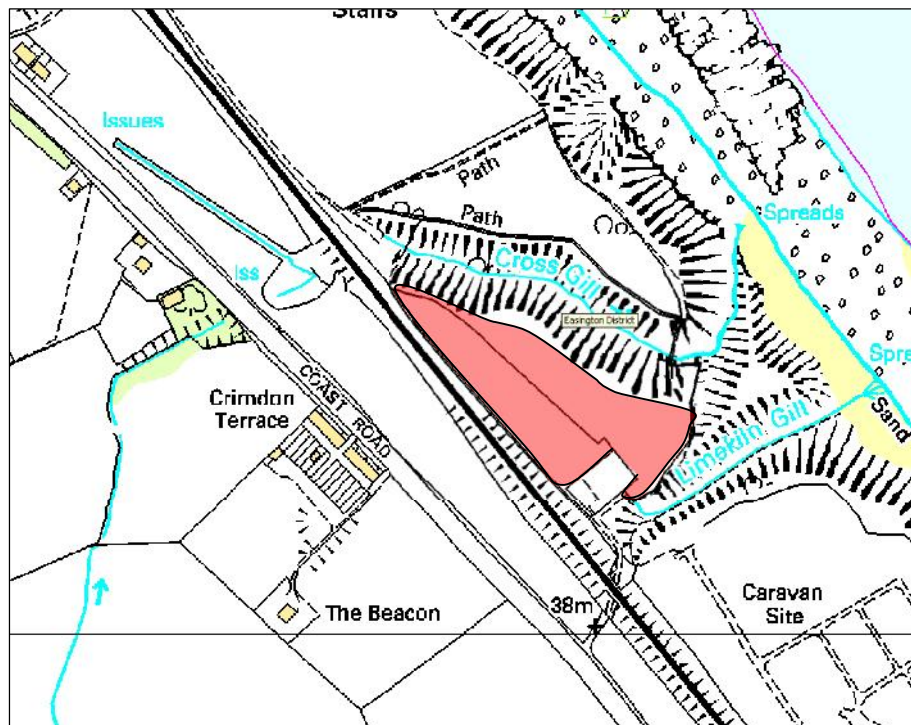
All of the land within the current project area is either owned or leased to one of the following organisations:

- Durham County Council
- Durham Wildlife Trust
- National Trust
- Grassland Trust

Summary of findings

There are a number of herb-rich unimproved grasslands along this section of the Durham coast which have fortunately survived to the present day and thus have much potential as future donor sites for wildflower seed collection. The following key grasslands were identified as having potential suitability for some mechanical and / or hand-collection of wildflower seed;

1. Cross Gill (Grassland Trust), NZ475382



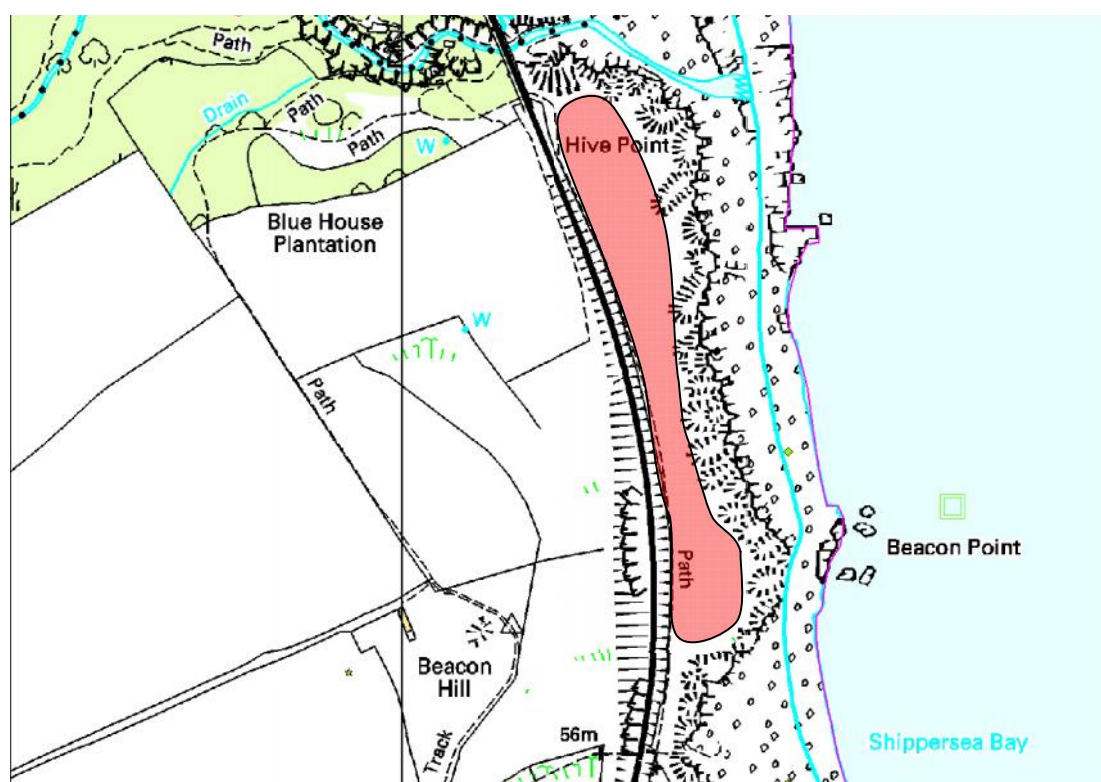
The grassland area south of Cross Gill itself appears to display the rigg and furrow feature which is often indicative of old permanent pastures. The herb-rich sward contains many key indicator species of unimproved neutral to calcareous grasslands including pepper saxifrage (*Silaum silaus*), betony (*Stachys officinalis*), common knapweed (*Centaurea nigra*), yellow rattle (*Rhinanthus minor*), birdsfoot trefoil (*Lotus corniculatus*), devilsbit scabious (*Succisa pratensis*) and zigzag clover (*Trifolium medium*). The principal grasses present here are sweet vernal (*Anthoxanthum odoratum*), red fescue (*Festuca rubra*), common bent (*Agrostis capillaris*) and yellow oat-grass (*Trisetum flavescens*), all species typical of semi-natural grassland habitats. Small quantities of ling (*Calluna vulgaris*) also occur with other normally

calcifugous species such as tormentil (*Potentilla erecta*), heath groundsel (*Senecio sylvaticus*) and gorse (*Ulex europaeus*) and add diversity to this important remnant of unfertilised coastal grassland.

Gorse appears to have spread widely across much of the site following a cessation of grazing but the remaining key open areas are located on mostly even ground (apart from the ridge and furrow pattern) and could therefore be accessed by a mechanical brush harvester.

Optimal time for seed collection – August / early September.

2. Beacon Point to Hive Point (National Trust), NZ443454



An exceptional area of unimproved coastal grassland that probably survived agricultural improvement because of its isolated location on the narrow seaward side of the east coast railway line. The grassland which is damp in places contains the largest population of the uncommon saw-wort (*Serratula tinctoria*) in County Durham together with a wealth of grassland herbs including agrimony (*Agrimonia eupatoria*), devilsbit scabious, early purple orchid (*Orchis mascula*), spiny restharrow (*Ononis spinosa*), burnet saxifrage (*Pimpinella saxifraga*), pepper saxifrage, wild marjoram (*Origanum vulgare*) and many more.

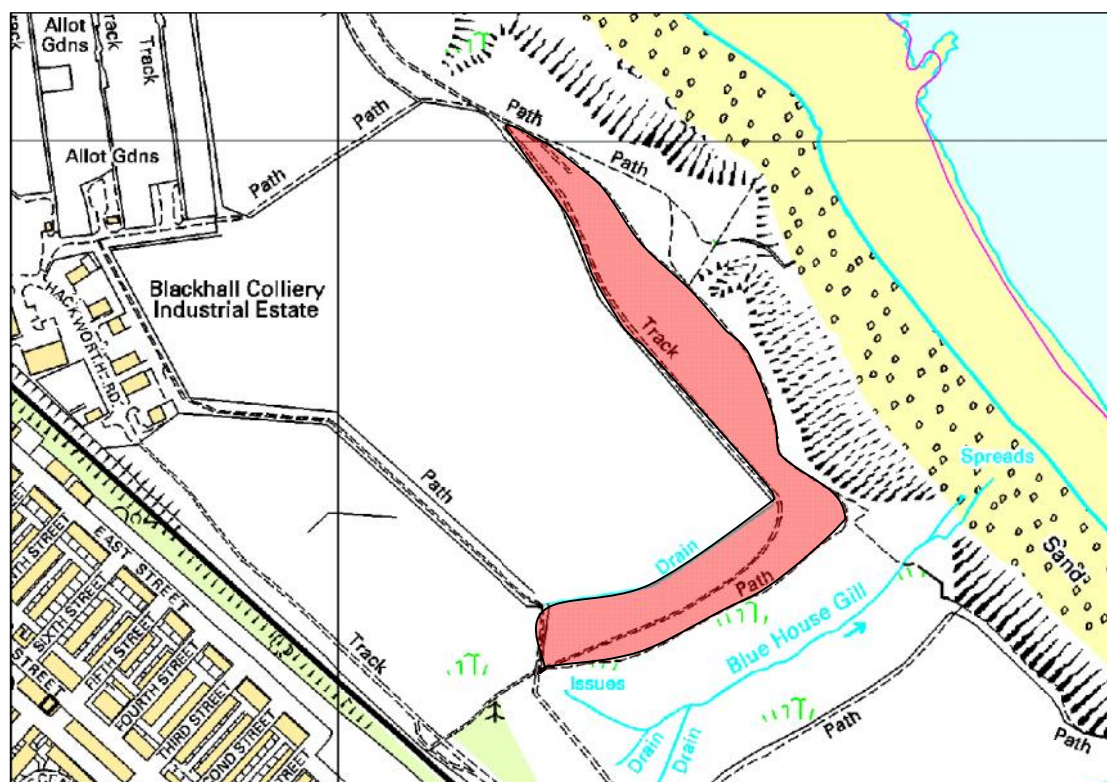
The grassland has recently been managed by annual mowing and raking but would appear not to have been cut in 2010 judging by the small quantities of insipient woody scrub that were present at the time of survey. Bracken encroachment is a particular problem here and will spread rapidly without

control. The presence of 9 species of waxcap fungi recorded here in 2008 fruiting within the aftermath thatch is a strong confirmation of the very low nutrient levels within the soil here.

The level grassland could be accessed relatively easily by a mechanical brush harvester to obtain wild flower seed.

Optimal time for seed collection – August / early September.

3. Blackhall Rocks Nature Reserve (DWT), NZ464396

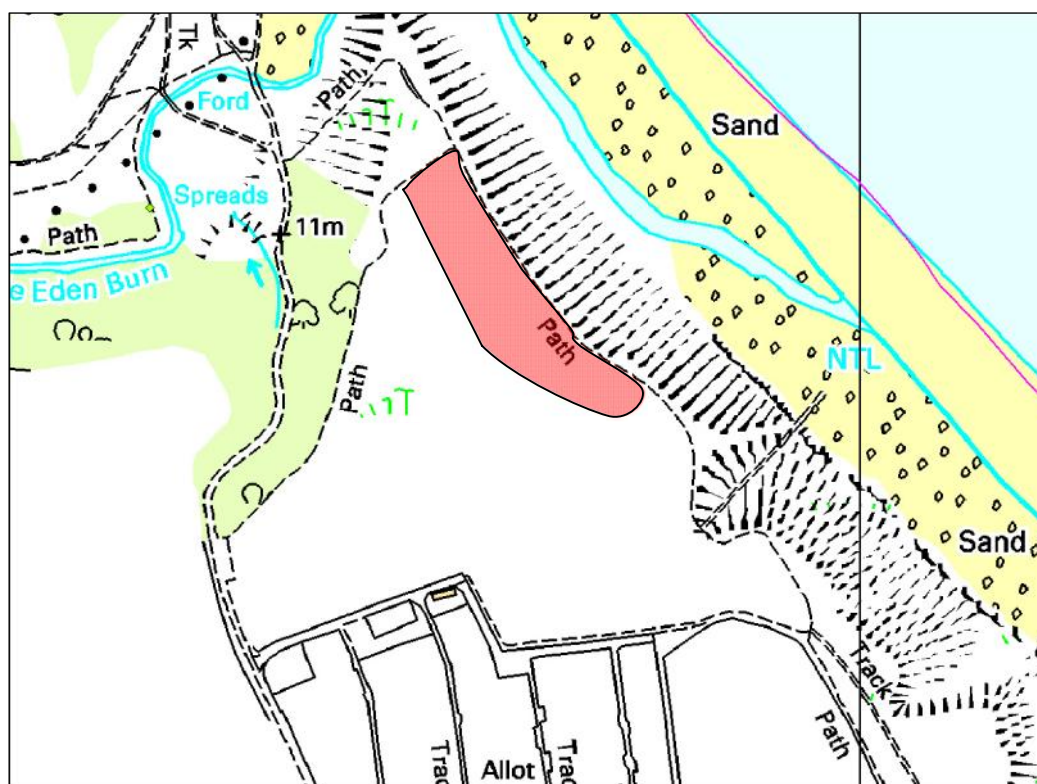


Two areas of species-rich Magnesian limestone grassland situated north of Blue House Gill. The sward is notably sparse throughout much of the grassland and is at least partially developed over former coal workings. A large number of typical indicator species are present including autumn gentian (*Gentianella amarella*), kidney vetch (*Anthyllis vulneraria*), hoary plantain (*Plantago media*), small scabious (*Scabiosa columbaria*), greater knapweed (*Centaurea scabiosa*), carline thistle (*Carlina vulgaris*) and cowslip (*Primula veris*). The origin of horseshoe vetch (*Hippocrepis comosa*) and clustered bellflower (*Campanula glomerata*) is unclear but both of these southern calcicolous species are also well established here.

The grasslands are situated on more or less level ground and would be accessible for a mechanical brush harvester or simple hand collecting of seed.

Optimal time for seed collection – late June/July or August/early September

4. Blackhall Rocks Nature Reserve (DWT), NZ457405

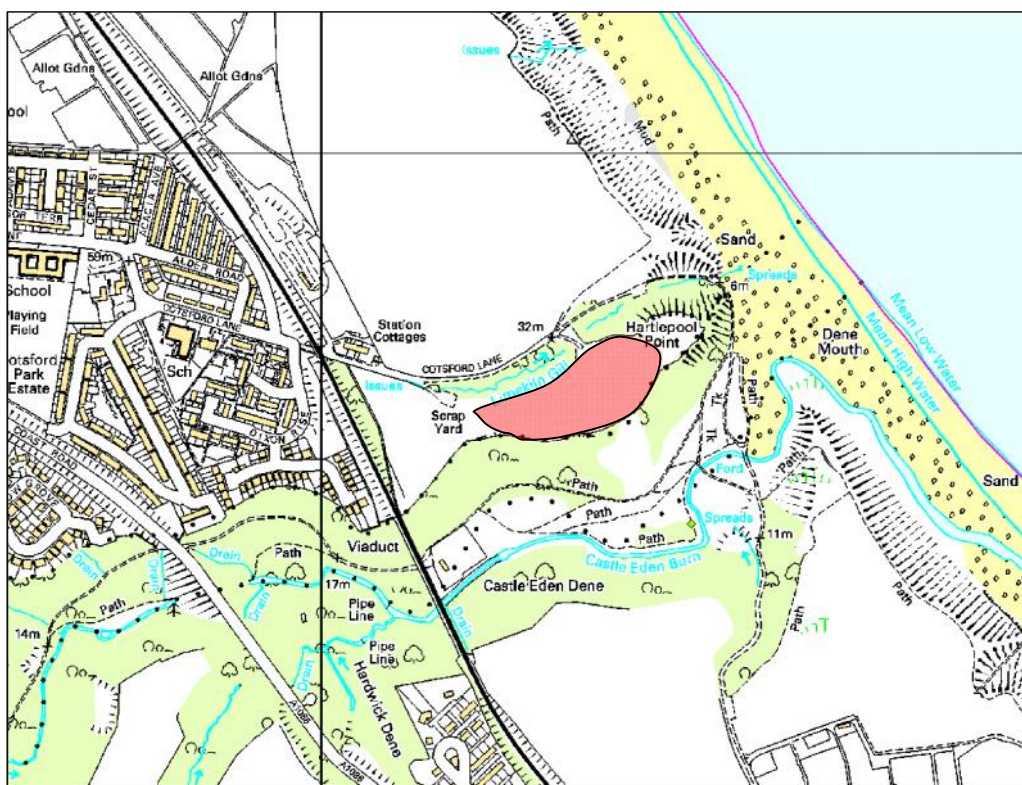


An area of varied grassland at the north western end of the reserve which contains damp unimproved neutral turf together with areas of Magnesian limestone grassland and surrounded by a scrub/tall herb mosaic. Typical calcicoles such as rough hawkbit (*Leontodon hispidus*), restharrow (*Ononis repens*), fairy flax (*Linum catharticum*) and yellow-wort (*Blackstonia perfoliata*) are present with damp grassland herbs like sneezewort (*Achillea ptarmica*), northern marsh orchid (*Dactylorhiza purpurella*), fleabane (*Pulicaria dysenterica*), meadowsweet (*Filipendula ulmaria*) and several sedge and rush species.

The grasslands are situated on more or less level ground and would be accessible for a mechanical brush harvester or simple hand collecting of seed.

Optimal time for seed collection – late July to early September

5. Land between Limekiln Gill and Denemouth (DCC), NZ454406



A recently fenced area containing unimproved neutral grassland with damp aspects. The pasture contains a large number of herbs characteristic of unmodified grasslands including hairy ladies mantle (*Alchemilla filicaulis* ssp. *vestita*), yellow rattle, zigzag clover, knapweed, birdsfoot trefoil, harebell (*Campanula rotundifolia*), agrimony, tormentil and meadow vetchling (*Lathyrus pratensis*). The damper parts contain square stalked St. John's wort (*Hypericum tetrapterum*) with both northern marsh and common spotted orchids and wild angelica (*Angelica sylvestris*), marsh thistle (*Cirsium palustre*) and glaucous sedge (*Carex flacca*).

The potentiality of this grassland as a future donor site will be dependent upon the establishment of an appropriate grazing regime (i.e. livestock excluded April to August to allow seed development).

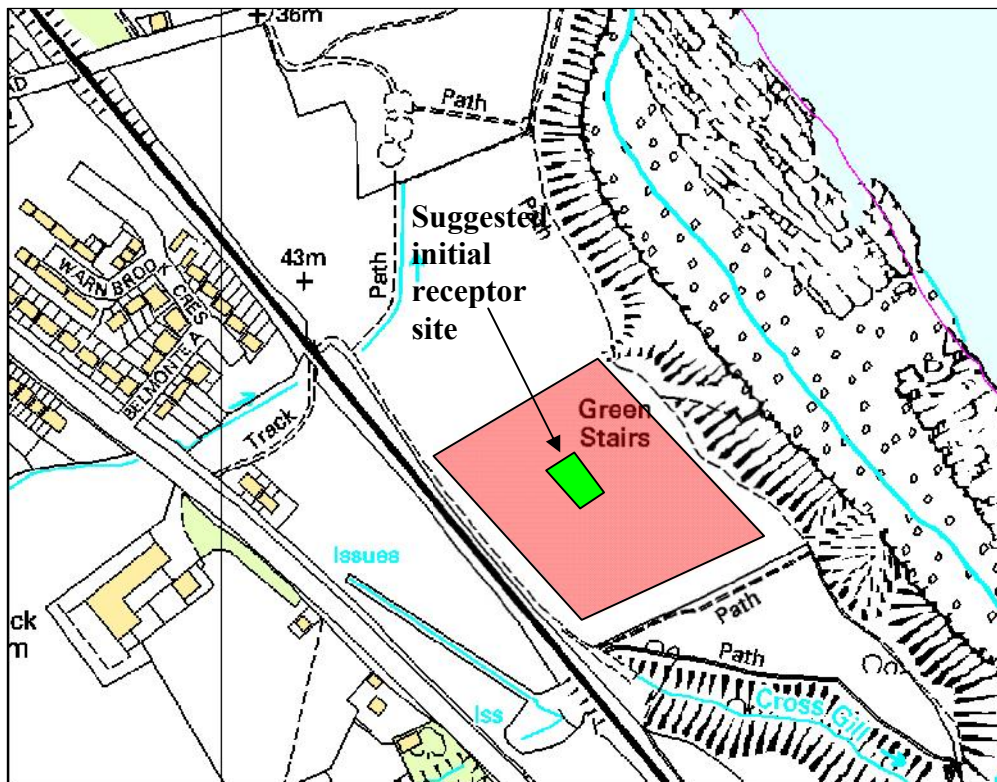
The grassland is undulating in places but could be accessed relatively easily by a mechanical brush harvester.

Optimal time for seed collection – late July to late August

Potential receptor sites

Although all of the potential receptor sites display a certain degree of uniformity due to their former land use and proximity, each site also displays subtle individual facets which may influence and help direct future grassland restoration works. The principal receptor sites identified are detailed below.

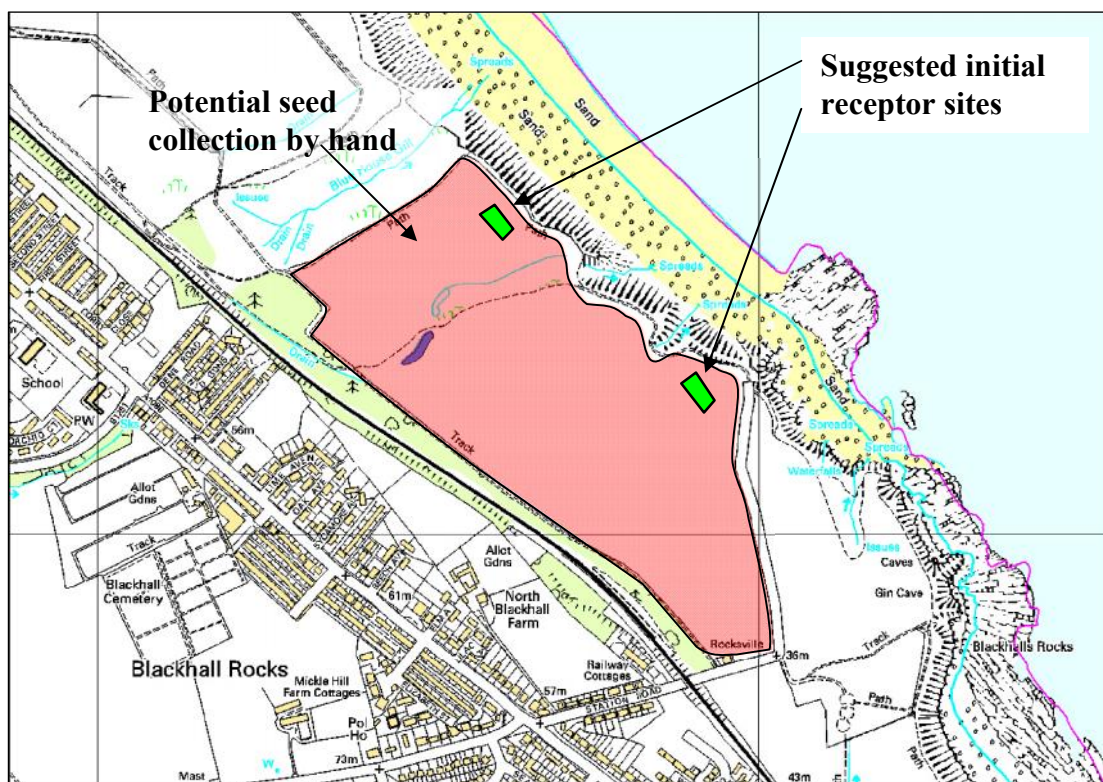
1. Fields 0369, 2653 (DCC), NZ473384



A substantial area has been recently fenced to facilitate future grazing management. The former arable land was previously re-sown with a standard neutral grassland wildflower mix and the parcel is currently dominated by leguminous forbs such as red clover (*Trifolium pratense*), white clover (*Trifolium repens*) and the frequently sown upright form of birdsfoot trefoil (*Lotus corniculatus* ssp. *sativa*). Lesser amounts of yellow rattle, rough hawkbit, common knapweed, meadow vetchling, betony and wild carrot (*Daucus carota*) are also present. Creeping bent (*Agrostis stolonifera*), Yorkshire fog (*Holcus lanatus*) and red fescue are the main grass species present.

Recommended donor site: - Cross Gill
Method of seed collection – brush harvester

2. Fields 5141, 7309 (DCC), NZ465393



A very large area of former arable that has been similarly re-sown with a neutral grassland wildflower mix. The field has a similar composition to that described above but contains an unusual abundance of wild carrot and also supports small quantities of herb species which might be the product of natural recruitment from adjacent established grassland. These include small quantities of desirable species like great burnet (*Sanguisorba officinalis*), zigzag clover, field scabious (*Knautia arvensis*), fleabane, hemp agrimony and hoary ragwort (*Senecio erucifolius*). Along the upper half of the field where a telegraph line crosses the sward is considerably shorter and contains colonists such as yellow-wort, eyebright (*Euphrasia spp.*) and common centaury (*Centaurea erythraea*).

The northern edge of the field directly adjacent to Blue House Gill is fairly species-rich and presumably represents a relict unploughed field edge community. Knapweed, devilsbit scabious and other herbs appear to be slowly advancing into the wider grassland here.

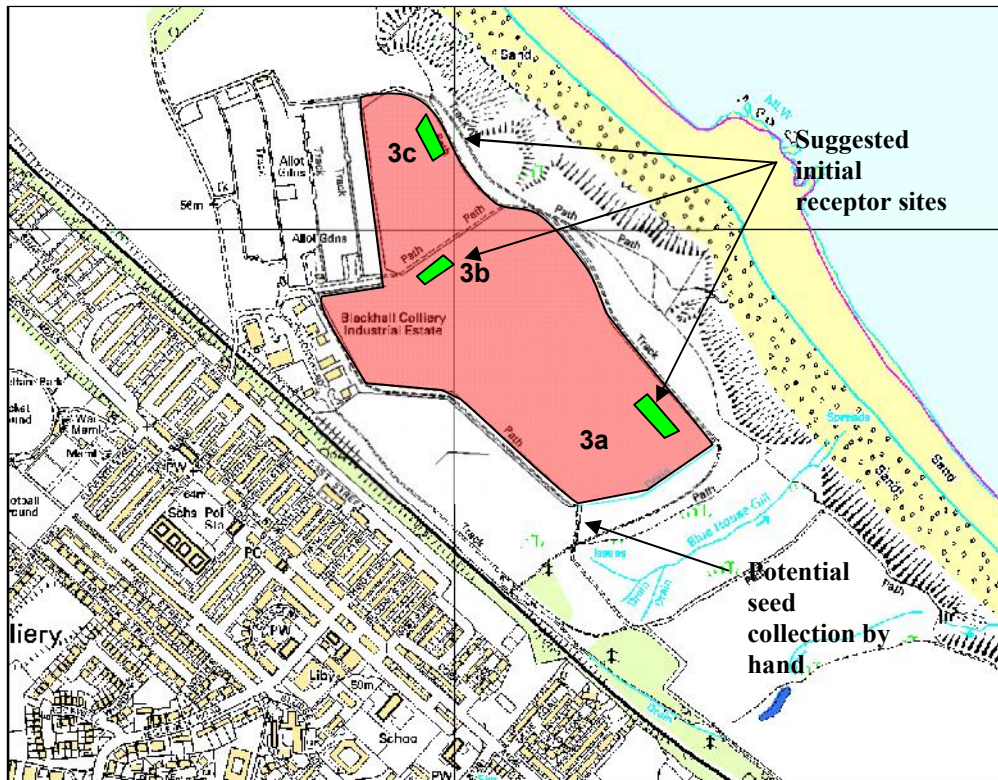
Recommended donor site: - Cross Gill

Method of seed collection – brush harvester

*Additional seed collection by hand from areas shown on plan **

** See Appendix 1 for targeted list of recommended species*

3. Fields 9508, 1187 (DCC), NZ462396



The fields have been divided up into three units for future grazing management;

3a. The most southerly fenced area adjacent to Blue House Gill has a slightly finer, sparser and more interesting sward than the others and contains a good deal of quaking grass (*Briza media*) with birdsfoot trefoil and kidney vetch. Small amounts of yellow rattle and common spotted orchid were also present and glaucous sedge was particularly frequent on the lower damper slopes.

Recommended donor site: - Blackhall Rocks NR (Site 3)

Method of seed collection – brush harvester

*Additional seed collection by hand from areas shown on plan **

** See Appendix 1 for targeted list of recommended species*

3b. The central fenced unit has a much lower herb content and contains large amounts of coarse grasses such as false oat-grass (*Arrhenatherum elatius*), but otherwise has a fairly similar floristic composition. Tethered horse grazing was taking place in this unit at the time of survey.

Recommended donor site: - Blackhall Rocks NR (Site 4)

Method of seed collection – brush harvester

*Additional seed collection by hand from areas shown on plan **

** See Appendix 1 for targeted list of recommended species*

3c. The northern-most fenced unit is somewhat intermediate between the two previous, having a fairly low sward but was however largely dominated by clovers.

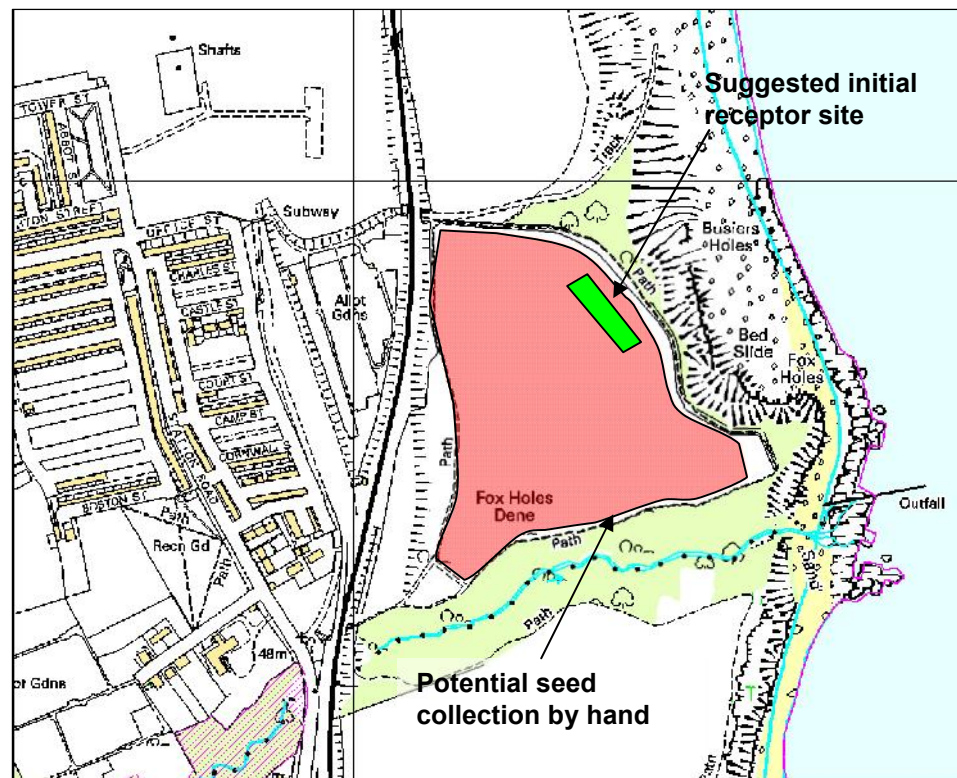
Recommended donor site: - Blackhall Rocks NR (Sites 3 and 4)

Method of seed collection – brush harvester

*Additional seed collection by hand from areas shown on plan **

** See Appendix 1 for targeted list of recommended species*

4. Field north of Foxholes Dene (NT), NZ443438



A large field between Foxholes Dene and Busier's Hole. Former arable and re-sown with a neutral grassland wildflower mix. Regular hay cuts have been taken and the field had been recently mown at the time of survey. Small quantities of desirable herb species were present including birdsfoot trefoil, common knapweed, fleabane, hemp agrimony, tufted vetch (*Vicia cracca*), goatsbeard (*Tragopogon pratensis*), common catsear (*Hypochaeris radicata*) and hoary ragwort.

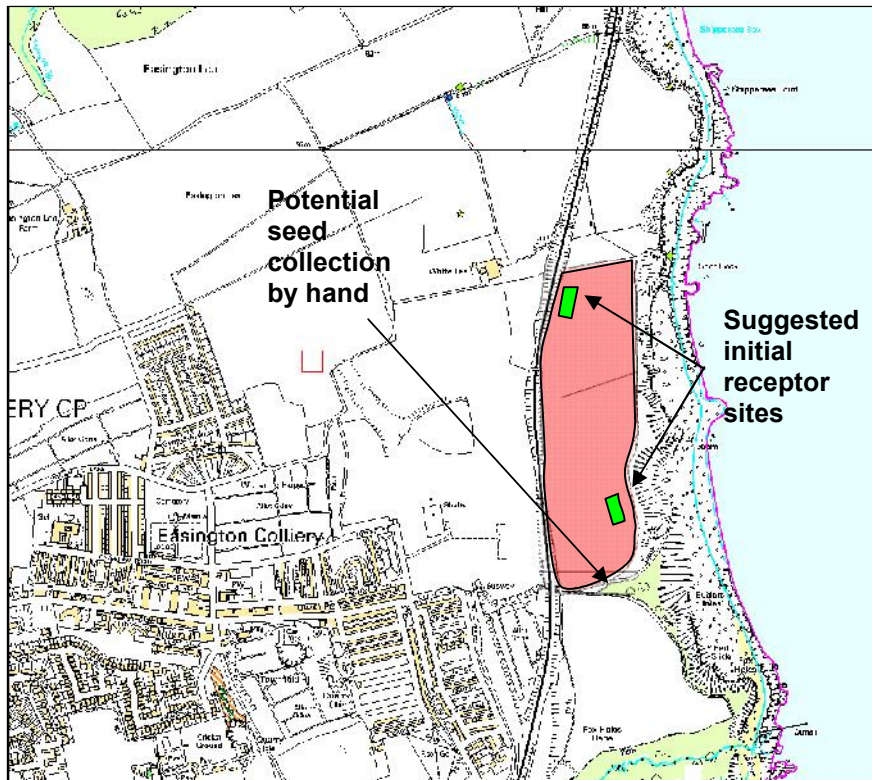
Recommended donor site: - Beacon Point to Hive Point

Method of seed collection – brush harvester

*Additional seed collection by hand from areas shown on plan **

** See Appendix 1 for targeted list of recommended species*

5. Field north of Busier's Hole (NT), NZ442442



A large field with a similar history to receptor site 4 and also recently cut for hay. It is perhaps more *Arrhenatherum*-dominated than the previous and additionally contains wild strawberry (*Fragaria vesca*), smooth hawksbeard (*Crepis capillaris*), fox and cubs (*Pilosella aurantiacum*) and scattered clumps of common male fern (*Dryopteris filix-mas*).

Busier's Hole itself supports small quantities of damp herb-rich neutral and Magnesian limestone grassland with typical species like northern marsh orchid, zigzag clover, kidney vetch, glaucous sedge and yellow-wort.

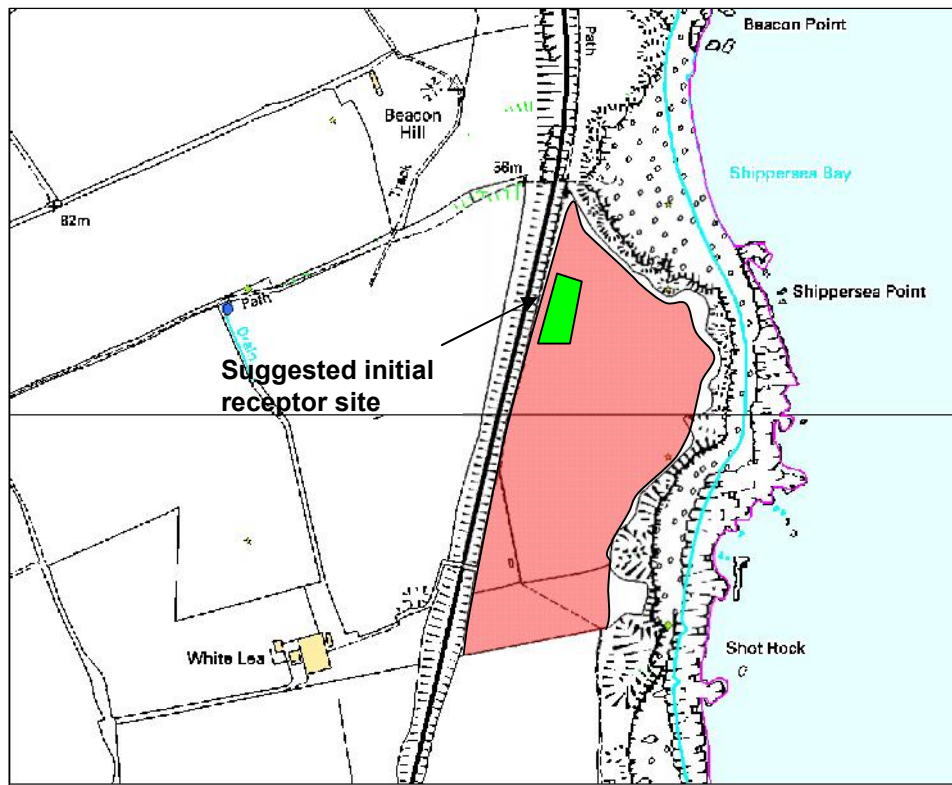
Recommended donor site: - Beacon Point to Hive Point

Method of seed collection – brush harvester

*Additional seed collection by hand from areas shown on plan **

** See Appendix 1 for targeted list of recommended species*

6. Field south of Shippersea Point (NT), NZ442450



A large grazed improved pasture dominated by perennial rye grass (*Lolium perenne*) and white clover. Although the current herb content is low, there is evidence of a slow recovery and recruitment of semi-natural neutral grassland species such as red fescue, birdsfoot trefoil, smooth hawksbeard, red clover, rough hawkbit and common catsear.

Recommended donor site: - Beacon Point to Hive Point
Method of seed collection – brush harvester

Discussion

It should be stressed that the implementation of future conservation grazing within the receptor sites will be paramount to the success of potential wild flower seed transfer. Regular grazing essentially will steadily reduce nutrient levels and lower competition from the more vigorous grasses such as false oat grass and cocksfoot (*Dactylis glomerata*). The current dominance of both red and white clover in several of the fields should also be reduced in favour of a more floristically diverse sward. Most importantly, conservation grazing should aim to maintain an open sward which would allow successful seedling establishment.

It should additionally be realised that the process of grassland restoration from former arable land is a long term goal which is likely to take many decades to achieve. The close proximity of established unimproved herb-rich grasslands to the receptor sites is fortunate and has already allowed a certain degree of natural recruitment to take place. This natural colonisation should always be encouraged wherever possible. The present study has attempted to identify those existing stands of semi-natural vegetation located nearest to the receptor sites for recommendation as potential donor grasslands.

Hopefully this should help maintain floristic integrity in future and most closely resemble the plant communities formerly present.

An attempt was made to identify field edge communities consisting of grassland herbs which in many cases might be representative of the former vegetation. Such species are likely to have been eradicated from the main field but have continued to persist along unploughed field margins and track sides. In such cases hand collection of seed has been recommended.

All of the recommended potential donor sites are situated on either level or gently undulating ground in order to facilitate access by machinery, e.g. a brush harvester. For this reason the abundant herb-rich grasslands of the sea cliffs and steep slopes of the gills have been omitted. The recommendations for hand collection of seed have similarly avoided these areas for safety reasons.

Appendix 1 below lists those key regional grassland indicator species most appropriate for seed transfer and identifies suitable times for seed harvesting. It will be seen that there are two clearly defined periods of seed maturity, the first in late June for those spring flowering species and the second in late Aug/early September for summer grassland flowers. The list is not exhaustive but could be augmented by reference to the site descriptions and species lists contained within this report. Those species highlighted in blue have been selected as most appropriate for monitoring the success of seed transfer in future. For this purpose an attempt was made to select grassland indicator species that would be most easily recognisable in the field, e.g. cowslip. Additionally the species chosen are all relatively widespread within the donor sites outlined above and have all been used in successful seed transfer projects elsewhere in the region.

Appendices

Appendix 1. Table showing target grassland species with optimum time for seed collection.

Species - latin	Species - English	Seed ripe	Site
<i>Achillea ptarmica</i>	Sneezewort	Aug/early Sep	Blackhall Rocks
<i>Agrimonia eupatoria</i>	Common Agrimony	Aug/early Sep	All
<i>Anthyllis vulneraria</i>	Kidney Vetch	Late June >	All
<i>Carex flacca</i>	Glaucous Sedge	Late June >	All
<i>Centaurea nigra</i>	Common Knapweed	Aug/early Sep	All
<i>Dactylorhiza fuchsii</i>	Common Spotted Orchid	Aug/early Sep	All
<i>Dactylorhiza purpurella</i>	Northern Marsh Orchid	Late June >	All
<i>Gentianella amarella</i>	Autumn Gentian	Late Aug/Sept	Blackhall Rocks
<i>Geranium pratense</i>	Meadow Cranesbill	Aug/early Sep	All
<i>Knautia arvensis</i>	Field Scabious	Aug/early Sep	All
<i>Lathyrus pratensis</i>	Meadow Vetchling	Late June >	All
<i>Leontodon hispidus</i>	Rough Hawkbit	Late June >	All
<i>Lotus corniculatus</i>	Common Birdsfoot Trefoil	Late June >	All
<i>Origanum vulgare</i>	Wild Marjoram	Aug/early Sep	Beacon Point
<i>Pimpinella saxifraga</i>	Burnet saxifrage	Aug/early Sep	All
<i>Primula veris</i>	Cowslip	Late June >	All
<i>Rhinanthus minor</i>	Yellow Rattle	Mid July >	All
<i>Scabiosa columbaria</i>	Small Scabious	Aug/early Sep	Blackhall Rocks, Beacon Point
<i>Serratua tinctoria</i>	Saw-wort	Aug/early Sep	Beacon Point
<i>Silaum silaus</i>	Pepper saxifrage	Aug/early Sep	Cross Gill, Beacon Point
<i>Stachys officinalis</i>	Betony	Aug/early Sep	Cross Gill, Beacon Point
<i>Succisa pratensis</i>	Devilsbit Scabious	Aug/early Sep	All
<i>Trifolium medium</i>	Zigzag Clover	Aug/early Sep	All

Appendix 2. Site species data

Donor site 1 (Cross Gill) NZ475382

<i>Agrostis capillaris</i>	Common Bent	Occasional	17-Aug-11
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	Frequent	17-Aug-11
<i>Calluna vulgaris</i>	Heather	Rare	17-Aug-11
<i>Campanula rotundifolia</i>	Harebell	Rare	17-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Abundant	17-Aug-11
<i>Dactylorhiza fuchsii</i>	Common Spotted-orchid	Rare	17-Aug-11
<i>Daucus carota</i>	Carrot	Occasional	17-Aug-11
<i>Festuca rubra</i>	Red Fescue	Frequent	17-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Rare	17-Aug-11
<i>Hieracium agg.</i>	Hawkweed	Rare	17-Aug-11
<i>Hypochaeris radicata</i>	Cat's-ear	Occasional	17-Aug-11
<i>Leontodon autumnalis</i>	Autumn Hawkbit	Rare	17-Aug-11
<i>Leontodon hispidus</i>	Rough Hawkbit	Frequent	17-Aug-11
<i>Leucanthemum vulgare</i>	Oxeye Daisy	Rare	17-Aug-11
<i>Linum catharticum</i>	Fairy Flax	Rare	17-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Frequent	17-Aug-11
<i>Pimpinella saxifraga</i>	Burnet-saxifrage	Frequent	17-Aug-11
<i>Plantago lanceolata</i>	Ribwort Plantain	Frequent	17-Aug-11
<i>Potentilla erecta</i>	Tormentil	Occasional	17-Aug-11
<i>Primula veris</i>	Cowslip	Rare	17-Aug-11
<i>Pulicaria dysenterica</i>	Common Fleabane	Rare	17-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Occasional	17-Aug-11
<i>Senecio erucifolius</i>	Hoary Ragwort	Occasional	17-Aug-11
<i>Senecio jacobaea</i>	Common Ragwort	Rare	17-Aug-11
<i>Senecio sylvaticus</i>	Heath Groundsel	Rare	17-Aug-11
<i>Silaum silaus</i>	Pepper-saxifrage	Occasional	17-Aug-11
<i>Stachys officinalis</i>	Betony	Frequent	17-Aug-11
<i>Succisa pratensis</i>	Devil's-bit Scabious	Occasional	17-Aug-11
<i>Trifolium medium</i>	Zigzag Clover	Rare	17-Aug-11
<i>Trifolium pratense</i>	Red Clover	Occasional	17-Aug-11
<i>Trisetum flavescens</i>	Yellow Oat-grass	Rare	17-Aug-11
<i>Ulex europaeus</i>	Gorse	Rare	17-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Rare	17-Aug-11
<i>Viola riviniana</i>	Common Dog-violet	Rare	17-Aug-11

Donor site 2 (Beacon Point to Hive Point) NZ443454

<i>Achillea millefolium</i>	Yarrow	Rare	19-Aug-11
<i>Agrimonia eupatoria</i>	Agrimony	Occasional	19-Aug-11
<i>Agrostis stolonifera</i>	Creeping Bent	Frequent	19-Aug-11
<i>Angelica sylvestris</i>	Wild Angelica	Occasional	19-Aug-11
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	Occasional	19-Aug-11
<i>Arrhenatherum elatius</i>	False Oat-Grass	Occasional	19-Aug-11
<i>Blackstonia perfoliata</i>	Yellow-wort	Rare	19-Aug-11
<i>Brachypodium sylvaticum</i>	False-brome	Rare	19-Aug-11
<i>Briza media</i>	Quaking-grass	Frequent	19-Aug-11
<i>Calluna vulgaris</i>	Heather	Rare	19-Aug-11
<i>Campanula rotundifolia</i>	Harebell	Occasional	19-Aug-11
<i>Carex flacca</i>	Glaucous Sedge	Occasional	19-Aug-11
<i>Carex pulicaris</i>	Flea Sedge	Rare	19-Aug-11

<i>Centaurea nigra</i>	Common Knapweed	Frequent	19-Aug-11
<i>Centaurea scabiosa</i>	Greater Knapweed	Rare	19-Aug-11
<i>Centaureum erythraea</i>	Common Centaury	Rare	19-Aug-11
<i>Convolvulus arvensis</i>	Field Bindweed	Rare	19-Aug-11
<i>Dactylis glomerata</i>	Cock's-foot	Rare	19-Aug-11
<i>Daucus carota</i>	Carrot	Rare	19-Aug-11
<i>Equisetum arvense</i>	Field Horsetail	Occasional	19-Aug-11
<i>Euphrasia officinalis</i> agg.	Eyebright	Rare	19-Aug-11
<i>Festuca arundinacea</i>	Tall Fescue	Occasional	19-Aug-11
<i>Festuca rubra</i>	Red Fescue	Frequent	19-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Occasional	19-Aug-11
<i>Galium verum</i>	Lady's Bedstraw	Rare	19-Aug-11
<i>Geranium sanguineum</i>	Bloody Crane's-bill	Occasional	19-Aug-11
<i>Helictotrichon pratense</i>	Meadow Oat-grass	Occasional	19-Aug-11
<i>Hieracium</i> agg.	Hawkweed	Occasional	19-Aug-11
<i>Hypericum perforatum</i>	Perforate St John's-wort	Rare	19-Aug-11
<i>Knautia arvensis</i>	Field Scabious	Rare	19-Aug-11
<i>Lathyrus pratensis</i>	Meadow Vetchling	Rare	19-Aug-11
<i>Leontodon hispidus</i>	Rough Hawkbit	Frequent	19-Aug-11
<i>Leucanthemum vulgare</i>	Oxeye Daisy	Rare	19-Aug-11
<i>Linum catharticum</i>	Fairy Flax	Rare	19-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Occasional	19-Aug-11
<i>Ononis spinosa</i>	Spiny Restharrow	Occasional	19-Aug-11
<i>Orchis mascula</i>	Early-purple Orchid	Rare	19-Aug-11
<i>Pimpinella saxifraga</i>	Burnet-saxifrage	Occasional	19-Aug-11
<i>Plantago lanceolata</i>	Ribwort Plantain	Frequent	19-Aug-11
<i>Plantago maritima</i>	Sea Plantain	Rare	19-Aug-11
<i>Polygala vulgaris</i>	Common Milkwort	Rare	19-Aug-11
<i>Potentilla erecta</i>	Tormentil	Occasional	19-Aug-11
<i>Potentilla reptans</i>	Creeping Cinquefoil	Rare	19-Aug-11
<i>Primula veris</i>	Cowslip	Occasional	19-Aug-11
<i>Pteridium aquilinum</i>	Bracken	Locally frequent	19-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Occasional	19-Aug-11
<i>Rosa canina</i> agg.	Dog-rose	Rare	19-Aug-11
<i>Rosa pimpinellifolia</i>	Burnet Rose	Rare	19-Aug-11
<i>Rubus fruticosus</i> agg.	Bramble	Occasional	19-Aug-11
<i>Sanguisorba minor</i>	Salad Burnet	Rare	19-Aug-11
<i>Senecio erucifolius</i>	Hoary Ragwort	Rare	19-Aug-11
<i>Serratula tinctoria</i>	Saw-wort	Abundant	19-Aug-11
<i>Silene silaus</i>	Pepper-saxifrage	Rare	19-Aug-11
<i>Stachys officinalis</i>	Betony	Occasional	19-Aug-11
<i>Succisa pratensis</i>	Devil's-bit Scabious	Frequent	19-Aug-11
<i>Thalictrum minus</i>	Lesser Meadow-rue	Rare	19-Aug-11
<i>Trifolium medium</i>	Zigzag Clover	Occasional	19-Aug-11
<i>Tussilago farfara</i>	Colt's-foot	Rare	19-Aug-11
<i>Ulex europaeus</i>	Gorse	Rare	19-Aug-11
<i>Viola riviniana</i>	Common Dog-violet	Rare	19-Aug-11

Donor site 3 (Blackhall Rocks NR) NZ464396

<i>Achillea millefolium</i>	Yarrow	Occasional	17-Aug-11
<i>Agrostis stolonifera</i>	Creeping Bent	Abundant	17-Aug-11
<i>Anthyllis vulneraria</i>	Kidney Vetch	Frequent	17-Aug-11
<i>Blackstonia perfoliata</i>	Yellow-wort	Occasional	17-Aug-11

<i>Brachypodium sylvaticum</i>	False-brome	Occasional	17-Aug-11
<i>Campanula glomerata</i>	Clustered Bellflower	Rare	17-Aug-11
<i>Campanula rotundifolia</i>	Harebell	Rare	17-Aug-11
<i>Carex flacca</i>	Glaucous Sedge	Rare	17-Aug-11
<i>Carlina vulgaris</i>	Carlina Thistle	Rare	17-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Rare	17-Aug-11
<i>Centaurea scabiosa</i>	Greater Knapweed	Occasional	17-Aug-11
<i>Centaureum erythraea</i>	Common Centaury	Occasional	17-Aug-11
<i>Clinopodium vulgare</i>	Wild Basil	Occasional	17-Aug-11
<i>Daucus carota</i>	Carrot	Occasional	17-Aug-11
<i>Euphrasia officinalis agg.</i>	Eyebright	Occasional	17-Aug-11
<i>Galium verum</i>	Lady's Bedstraw	Occasional	17-Aug-11
<i>Gentianella amarella</i>	Autumn Gentian	Occasional	17-Aug-11
<i>Geranium sanguineum</i>	Bloody Crane's-bill	Rare	17-Aug-11
<i>Hippocrepis comosa</i>	Horseshoe Vetch	Rare	17-Aug-11
<i>Hypochaeris radicata</i>	Cat's-ear	Rare	17-Aug-11
<i>Leontodon hispidus</i>	Rough Hawkbit	Rare	17-Aug-11
<i>Leontodon saxatilis</i>	Lesser Hawkbit	Occasional	17-Aug-11
<i>Leucanthemum vulgare</i>	Oxeye Daisy	Rare	17-Aug-11
<i>Linum catharticum</i>	Fairy Flax	Occasional	17-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Abundant	17-Aug-11
<i>Medicago lupulina</i>	Black Medick	Occasional	17-Aug-11
<i>Ononis repens</i>	Common Restharrow	Rare	17-Aug-11
<i>Pilosella officinarum</i>	Mouse-ear-hawkweed	Rare	17-Aug-11
<i>Pimpinella saxifraga</i>	Burnet-saxifrage	Rare	17-Aug-11
<i>Plantago maritima</i>	Sea Plantain	Occasional	17-Aug-11
<i>Plantago media</i>	Hoary Plantain	Frequent	17-Aug-11
<i>Polygala vulgaris</i>	Common Milkwort	Rare	17-Aug-11
<i>Primula veris</i>	Cowslip	Occasional	17-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Rare	17-Aug-11
<i>Scabiosa columbaria</i>	Small Scabious	Locally frequent	17-Aug-11
<i>Succisa pratensis</i>	Devil's-bit Scabious	Rare	17-Aug-11
<i>Tragopogon pratensis</i>	Goat's-beard	Rare	17-Aug-11

Donor site 4 (Blackhall Rocks NR) NZ457405

<i>Achillea ptarmica</i>	Sneezewort	Rare	17-Aug-11
<i>Angelica sylvestris</i>	Wild Angelica	Rare	17-Aug-11
<i>Blackstonia perfoliata</i>	Yellow-wort	Occasional	17-Aug-11
<i>Briza media</i>	Quaking-grass	Rare	17-Aug-11
<i>Calluna vulgaris</i>	Heather	Occasional	17-Aug-11
<i>Campanula rotundifolia</i>	Harebell	Rare	17-Aug-11
<i>Carex flacca</i>	Glaucous Sedge	Frequent	17-Aug-11
<i>Carex otrubae</i>	False Fox-sedge	Rare	17-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Rare	17-Aug-11
<i>Centaureum erythraea</i>	Common Centaury	Rare	17-Aug-11
<i>Dactylorhiza fuchsii</i>	Common Spotted-orchid	Rare	17-Aug-11
<i>Dactylorhiza purpurella</i>	Northern Marsh-orchid	Rare	17-Aug-11
<i>Danthonia decumbens</i>	Heath-grass	Rare	17-Aug-11
<i>Daucus carota</i>	Carrot	Rare	17-Aug-11
<i>Eupatorium cannabinum</i>	Hemp-agrimony	Rare	17-Aug-11
<i>Euphrasia officinalis agg.</i>	Eyebright	Rare	17-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Rare	17-Aug-11
<i>Juncus articulatus</i>	Jointed Rush	Frequent	17-Aug-11

<i>Juncus conglomeratus</i>	Compact Rush	Occasional	17-Aug-11
<i>Juncus effusus</i>	Soft-rush	Rare	17-Aug-11
<i>Juncus inflexus</i>	Hard Rush	Occasional	17-Aug-11
<i>Lathyrus pratensis</i>	Meadow Vetchling	Rare	17-Aug-11
<i>Leontodon hispidus</i>	Rough Hawkbit	Rare	17-Aug-11
<i>Leucanthemum vulgare</i>	Oxeye Daisy	Rare	17-Aug-11
<i>Linum catharticum</i>	Fairy Flax	Occasional	17-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Frequent	17-Aug-11
<i>Ononis repens</i>	Common Restharrow	Rare	17-Aug-11
<i>Plantago maritima</i>	Sea Plantain	Occasional	17-Aug-11
<i>Pulicaria dysenterica</i>	Common Fleabane	Rare	17-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Occasional	17-Aug-11
<i>Stachys officinalis</i>	Betony	Rare	17-Aug-11
<i>Succisa pratensis</i>	Devil's-bit Scabious	Rare	17-Aug-11
<i>Trifolium medium</i>	Zigzag Clover	Rare	17-Aug-11
<i>Trifolium pratense</i>	Red Clover	Occasional	17-Aug-11
<i>Triglochin palustre</i>	Marsh Arrowgrass	Rare	17-Aug-11

Donor site 5 (land between Limekiln Gill and Denemouth) NZ454406

<i>Achillea millefolium</i>	Yarrow	Rare	17-Aug-11
<i>Agrimonia eupatoria</i>	Agrimony	Rare	17-Aug-11
<i>Agrostis capillaris</i>	Common Bent	Abundant	17-Aug-11
<i>Alchemilla filicaulis</i>	Common Lady's mantle	Rare	17-Aug-11
<i>Angelica sylvestris</i>	Wild Angelica	Rare	17-Aug-11
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	Occasional	17-Aug-11
<i>Calluna vulgaris</i>	Heather	Rare	17-Aug-11
<i>Campanula rotundifolia</i>	Harebell	Rare	17-Aug-11
<i>Carex flacca</i>	Glaucous Sedge	Frequent	17-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Occasional	17-Aug-11
<i>Chamerion angustifolium</i>	Rosebay Willowherb	Locally abundant	17-Aug-11
<i>Cirsium arvense</i>	Creeping Thistle	Occasional	17-Aug-11
<i>Cirsium palustre</i>	Marsh Thistle	Rare	17-Aug-11
<i>Crepis capillaris</i>	Smooth Hawk's-beard	Rare	17-Aug-11
<i>Cynosurus cristatus</i>	Crested Dog's-tail	Rare	17-Aug-11
<i>Dactylorhiza fuchsii</i>	Common Spotted-orchid	Rare	17-Aug-11
<i>Dactylorhiza purpurella</i>	Northern Marsh-orchid	Rare	17-Aug-11
<i>Equisetum arvense</i>	Field Horsetail	Rare	17-Aug-11
<i>Euphrasia officinalis</i> agg.	Eyebright	Occasional	17-Aug-11
<i>Festuca arundinacea</i>	Tall Fescue	Rare	17-Aug-11
<i>Festuca rubra</i>	Red Fescue	Frequent	17-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Rare	17-Aug-11
<i>Geranium pratense</i>	Meadow Crane's-bill	Rare	17-Aug-11
<i>Hypericum tetrapterum</i>	Square-stalked St John's-wort	Rare	17-Aug-11
<i>Lathyrus pratensis</i>	Meadow Vetchling	Rare	17-Aug-11
<i>Linum catharticum</i>	Fairy Flax	Rare	17-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Frequent	17-Aug-11
<i>Medicago lupulina</i>	Black Medick	Rare	17-Aug-11
<i>Plantago lanceolata</i>	Ribwort Plantain	Frequent	17-Aug-11
<i>Potentilla anserina</i>	Silverweed	Occasional	17-Aug-11
<i>Potentilla erecta</i>	Tormentil	Occasional	17-Aug-11
<i>Potentilla reptans</i>	Creeping Cinquefoil	Rare	17-Aug-11
<i>Ranunculus acris</i>	Meadow Buttercup	Occasional	17-Aug-11
<i>Ranunculus repens</i>	Creeping Buttercup	Occasional	17-Aug-11

<i>Rhinanthus minor</i>	Yellow-rattle	Frequent	17-Aug-11
<i>Rubus fruticosus</i> agg.	Bramble	Occasional	17-Aug-11
<i>Rumex obtusifolius</i>	Broad-leaved Dock	Occasional	17-Aug-11
<i>Senecio erucifolius</i>	Hoary Ragwort	Occasional	17-Aug-11
<i>Senecio jacobaea</i>	Common Ragwort	Rare	17-Aug-11
<i>Trifolium medium</i>	Zigzag Clover	Rare	17-Aug-11
<i>Trifolium pratense</i>	Red Clover	Occasional	17-Aug-11
<i>Trifolium repens</i>	White Clover	Rare	17-Aug-11
<i>Veronica chamaedrys</i>	Germander Speedwell	Rare	17-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Rare	17-Aug-11

Receptor site 1 (DCC fields 0369, 2653) NZ473384

<i>Agrostis stolonifera</i>	Creeping Bent	Abundant	17-Aug-11
<i>Arrhenatherum elatius</i>	False Oat-Grass	Occasional	17-Aug-11
<i>Carex flacca</i>	Glaucous Sedge	Rare	17-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Rare	17-Aug-11
<i>Cirsium arvense</i>	Creeping Thistle	Occasional	17-Aug-11
<i>Cynosurus cristatus</i>	Crested Dog's-tail	Occasional	17-Aug-11
<i>Dactylis glomerata</i>	Cock's-foot	Occasional	17-Aug-11
<i>Daucus carota</i>	Carrot	Occasional	17-Aug-11
<i>Epilobium hirsutum</i>	Great Willowherb	Rare	17-Aug-11
<i>Festuca rubra</i>	Red Fescue	Frequent	17-Aug-11
<i>Holcus lanatus</i>	Yorkshire-fog	Frequent	17-Aug-11
<i>Hypochaeris radicata</i>	Cat's-ear	Rare	17-Aug-11
<i>Lathyrus pratensis</i>	Meadow Vetchling	Occasional	17-Aug-11
<i>Leontodon hispidus</i>	Rough Hawkbit	Rare	17-Aug-11
<i>Lolium perenne</i>	Perennial Rye-grass	Occasional	17-Aug-11
<i>Lotus corniculatus</i> var. <i>sativus</i>		Frequent	17-Aug-11
<i>Medicago lupulina</i>	Black Medick	Rare	17-Aug-11
<i>Odontites vernus</i>	Red Bartsia	Occasional	17-Aug-11
<i>Plantago lanceolata</i>	Ribwort Plantain	Occasional	17-Aug-11
<i>Poa trivialis</i>	Rough Meadow-grass	Occasional	17-Aug-11
<i>Pulicaria dysenterica</i>	Common Fleabane	Rare	17-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Occasional	17-Aug-11
<i>Salix caprea</i>	Goat Willow	Rare	17-Aug-11
<i>Stachys officinalis</i>	Betony	Rare	17-Aug-11
<i>Trifolium dubium</i>	Lesser Trefoil	Rare	17-Aug-11
<i>Trifolium pratense</i>	Red Clover	Abundant	17-Aug-11
<i>Trifolium repens</i>	White Clover	Abundant	17-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Occasional	17-Aug-11
<i>Vicia sepium</i>	Bush Vetch	Rare	17-Aug-11
<i>Vicia tetrasperma</i>	Smooth Tare	Rare	17-Aug-11

Receptor site 2 (DCC fields 5141, 7309) NZ465393

<i>Anthyllis vulneraria</i>	Kidney Vetch	Occasional	17-Aug-11
<i>Blackstonia perfoliata</i>	Yellow-wort	Rare	17-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Rare	17-Aug-11
<i>Centaureum erythraea</i>	Common Centaury	Rare	17-Aug-11
<i>Chamerion angustifolium</i>	Rosebay Willowherb	Rare	17-Aug-11
<i>Clinopodium vulgare</i>	Wild Basil	Rare	17-Aug-11
<i>Euphrasia officinalis</i> agg.	Eyebright	Occasional	17-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Rare	17-Aug-11

<i>Galium verum</i>	Lady's Bedstraw	Rare	17-Aug-11
<i>Hypochaeris radicata</i>	Cat's-ear	Occasional	17-Aug-11
<i>Leontodon hispidus</i>	Rough Hawkbit	Occasional	17-Aug-11
<i>Lotus corniculatus</i> var. <i>sativus</i>		Frequent	17-Aug-11
<i>Melilotus altissimus</i>	Tall Melilot	Occasional	17-Aug-11
<i>Odontites vernus</i>	Red Bartsia	Occasional	17-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Occasional	17-Aug-11
<i>Sanguisorba officinalis</i>	Great Burnet	Rare	17-Aug-11
<i>Scabiosa columbaria</i>	Small Scabious	Rare	17-Aug-11
<i>Trifolium campestre</i>	Hop Trefoil	Occasional	17-Aug-11
<i>Trifolium medium</i>	Zigzag Clover	Rare	17-Aug-11
<i>Trifolium pratense</i>	Red Clover	Abundant	17-Aug-11
<i>Trifolium repens</i>	White Clover	Frequent	17-Aug-11
<i>Tussilago farfara</i>	Colt's-foot	Rare	17-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Occasional	17-Aug-11

Receptor site 3 (DCC fields 9508, 1187) NZ462396

<i>Agrostis stolonifera</i>	Creeping Bent	Abundant	17-Aug-11
<i>Anthyllis vulneraria</i>	Kidney Vetch	Occasional	17-Aug-11
<i>Blackstonia perfoliata</i>	Yellow-wort	Rare	17-Aug-11
<i>Briza media</i>	Quaking Grass	Frequent	17-Aug-11
<i>Carex flacca</i>	Glaucous Sedge	Frequent	17-Aug-11
<i>Centaureum erythraea</i>	Common Centaury	Rare	17-Aug-11
<i>Cirsium palustre</i>	Marsh Thistle	Rare	17-Aug-11
<i>Dactylorhiza fuchsii</i>	Common Spotted orchid	Rare	17-Aug-11
<i>Daucus carota</i>	Wild Carrot	Rare	17-Aug-11
<i>Euphrasia officinalis</i> agg.	Eyebright	Rare	17-Aug-11
<i>Festuca arundinacea</i>	Tall Fescue	Occasional	17-Aug-11
<i>Festuca rubra</i>	Red Fescue	Frequent	17-Aug-11
<i>Hypochaeris radicata</i>	Cat's-ear	Rare	17-Aug-11
<i>Leontodon autumnalis</i>	Autumn Hawkbit	Rare	17-Aug-11
<i>Lotus corniculatus</i>	Birdsfoot Trefoil	Frequent	17-Aug-11
<i>Medicago lupulina</i>	Black Medick	Occasional	17-Aug-11
<i>Odontites vernus</i>	Red Bartsia	Rare	17-Aug-11
<i>Pulicaria dysenterica</i>	Common Fleabane	Rare	17-Aug-11
<i>Rhinanthus minor</i>	Yellow-rattle	Rare	17-Aug-11
<i>Senecio erucifolius</i>	Hoary Ragwort	Occasional	17-Aug-11
<i>Trifolium campestre</i>	Hop Trefoil	Rare	17-Aug-11
<i>Trifolium dubium</i>	Lesser Trefoil	Rare	17-Aug-11
<i>Trifolium pratense</i>	Red Clover	Frequent	17-Aug-11
<i>Trifolium repens</i>	White Clover	Frequent	17-Aug-11
<i>Trisetum flavescens</i>	Yellow Oat-grass	Rare	17-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Rare	17-Aug-11

Receptor site 4 (NT field north of Foxholes Dene) NZ443438

<i>Achillea millefolium</i>	Yarrow	Present	19-Aug-11
<i>Agrostis stolonifera</i>	Creeping Bent	Present	19-Aug-11
<i>Angelica sylvestris</i>	Wild Angelica	Present	19-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Present	19-Aug-11
<i>Eupatorium cannabinum</i>	Hemp-agrimony	Present	19-Aug-11
<i>Festuca arundinacea</i>	Tall Fescue	Present	19-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Present	19-Aug-11

<i>Hypochaeris radicata</i>	Cat's-ear	Present	19-Aug-11
<i>Linaria vulgaris</i>	Common Toadflax	Present	19-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Present	19-Aug-11
<i>Medicago lupulina</i>	Black Medick	Present	19-Aug-11
<i>Odontites vernus</i>	Red Bartsia	Present	19-Aug-11
<i>Plantago lanceolata</i>	Ribwort Plantain	Present	19-Aug-11
<i>Pulicaria dysenterica</i>	Common Fleabane	Present	19-Aug-11
<i>Senecio erucifolius</i>	Hoary Ragwort	Present	19-Aug-11
<i>Tragopogon pratensis</i>	Goat's-beard	Present	19-Aug-11
<i>Trifolium campestre</i>	Hop Trefoil	Present	19-Aug-11
<i>Trifolium hybridum</i>	Alsike Clover	Present	19-Aug-11
<i>Trifolium pratense</i>	Red Clover	Present	19-Aug-11
<i>Trifolium repens</i>	White Clover	Present	19-Aug-11
<i>Tussilago farfara</i>	Colt's-foot	Present	19-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Present	19-Aug-11

Receptor site 5 (NT field north of Busier's Hole)

NZ442442

<i>Achillea millefolium</i>	Yarrow	Present	19-Aug-11
<i>Agrostis stolonifera</i>	Creeping Bent	Present	19-Aug-11
<i>Angelica sylvestris</i>	Wild Angelica	Present	19-Aug-11
<i>Arrhenatherum elatius</i>	False Oat-Grass	Present	19-Aug-11
<i>Centaurea nigra</i>	Common Knapweed	Present	19-Aug-11
<i>Crepis capillaris</i>	Smooth Hawk's-beard	Present	19-Aug-11
<i>Dryopteris filix-mas</i>	Male-fern	Present	19-Aug-11
<i>Eupatorium cannabinum</i>	Hemp-agrimony	Present	19-Aug-11
<i>Festuca arundinacea</i>	Tall Fescue	Present	19-Aug-11
<i>Filipendula ulmaria</i>	Meadowsweet	Present	19-Aug-11
<i>Fragaria vesca</i>	Wild Strawberry	Present	19-Aug-11
<i>Hypochaeris radicata</i>	Cat's-ear	Present	19-Aug-11
<i>Linaria vulgaris</i>	Common Toadflax	Present	19-Aug-11
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	Present	19-Aug-11
<i>Medicago lupulina</i>	Black Medick	Present	19-Aug-11
<i>Odontites vernus</i>	Red Bartsia	Present	19-Aug-11
<i>Pilosella aurantiaca</i>	Fox-and-cubs	Present	19-Aug-11
<i>Plantago lanceolata</i>	Ribwort Plantain	Present	19-Aug-11
<i>Potentilla reptans</i>	Creeping Cinquefoil	Present	19-Aug-11
<i>Pulicaria dysenterica</i>	Common Fleabane	Present	19-Aug-11
<i>Senecio erucifolius</i>	Hoary Ragwort	Present	19-Aug-11
<i>Tragopogon pratensis</i>	Goat's-beard	Present	19-Aug-11
<i>Trifolium campestre</i>	Hop Trefoil	Present	19-Aug-11
<i>Trifolium hybridum</i>	Alsike Clover	Present	19-Aug-11
<i>Trifolium pratense</i>	Red Clover	Present	19-Aug-11
<i>Trifolium repens</i>	White Clover	Present	19-Aug-11
<i>Tussilago farfara</i>	Colt's-foot	Present	19-Aug-11
<i>Vicia cracca</i>	Tufted Vetch	Present	19-Aug-11