

BOG OF THE RING

**Ecological monitoring programme
Year 1: 2004**

Final Report



***Enterprise Centre, The Murrough, Wicklow
Tel: 0404 66433 Fax: 0404 64022***

e-mail: info@natura.ie

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Ecological monitoring programme Year 1: 2004

1.0 INTRODUCTION

Natura Environmental Consultants were commissioned by PH McCarthy & Partners to set up a vegetation monitoring programme of the Bog of the Ring to determine if the vegetation has changed significantly since the baseline survey in 1999 (Natura 1999) and to establish reasons for the change. The Bog of the Ring is a proposed Natural Heritage Area and its protection is a requirement of the Fingal County Development Plan. This report is a re-evaluation of the baseline ecological survey carried out in 1999 and was undertaken from 5-9th August 2004.

2.0 BACKGROUND

2.1 Description of the site

Bog of the Ring is a wetland area situated approximately 5km south-west of Balbriggan in north Co. Dublin. It extends over 2km in length and is about 0.3km at its widest point. An area of elevated ground with residential dwellings divides the wetland areas of the site into East and West sections. The wetland is in a linear depression with impeded drainage. The substrate is peaty soil which is waterlogged in places but is quite dry over much of the site. Where the underlying subsoil is exposed along the banks of drainage ditches, a pale grey clay/stoney substrate is found. The adjacent land is predominantly agricultural and is comprised mainly of grassland with some tillage. A Sports Centre and sports pitches were developed some years ago in the middle of the eastern section. There is a network of drains and a stream on the site. Flow is to the east and the drains discharge into the Matt River. The recently constructed Balbriggan by-pass approximately defines the eastern boundary of the Bog of the Ring.

The study area for this project is the wetland area as defined by the pNHA boundary. The surrounding land is considered in terms of the impact that changing land use may have on the ecology of the wetland. The site is divided into a series of 'blocks' which are separated by boundary hedges, roadways, or streams/drains. The study area includes the proposed Natural Heritage Area (pNHA, code no. 1204) as defined by Dúchas, The Heritage Service.

2.2 Summary of results of the previous baseline study in 1999

2.2.1 Vegetation sampling

A vegetation monitoring programme was set up to monitor changes in the vegetation. Permanent square 2m x 2m quadrats were installed using wooden stakes and percentage cover and abundance values were measured using the Braun Blanquet and the DAFOR scales. The location of the quadrats was noted on the habitat map. In addition, three streamside samples were also taken throughout the site, noting the vegetation on the bank and in the stream using

the DAFOR scale only. Finally, five hedgerow lengths were identified and their condition noted.

2.2.2 Vegetation classification

Descriptions of the habitats of the site and surrounding areas in 1999 were made using the JNCC Phase 1 Habitat Survey methodology (Anon 1993). A more detailed vegetation description of the main habitats within the site was undertaken following the National Vegetation Classification (NVC) (Rodwell 1992) and a map of the different vegetation types was compiled using aerial photographs (Natura 1999). A more detailed classification of the vegetation of the main habitat type, marshy grassland was made, following the National Vegetation Classification (NVC) classification (Rodwell 1992). This corresponded closely to MG10; *Holcus lanatus* – *Juncus effusus* rush – pasture. Two sub-communities were also noted;

- *Juncus inflexus* sub-community where *J. inflexus* replaces *J. effusus* This sub-community occurs in less well-drained areas within more calcareous soils.
- *Iris pseudacorus* sub-community where iris is the most conspicuous species. In more open and damp areas, *Phalaris arundinacea* may be prominent. This vegetation is characteristic of permanently moist sites. Iris is locally dominant in Blocks 1, 5, 6 and 7. *Phalaris arundinacea* is particularly abundant in blocks 4 and 5.

2.2.3 Rare plants

Historically, the Bog of the Ring has had records of a number of rare plants dating back to the end of the last century (Doogue *et al.* 1998). An inventory was compiled of the 16 species recorded from the site and the status of each of these was investigated in the field (Natura 1999). None of the species mentioned are protected under the Flora Protection Order or listed in the Irish flora Red Data Book. Only three of the rare plants formerly known from the site were refound during the 1999 survey. These were celery-leaved buttercup (*Ranunculus sceleratus*) and thread-leaved water-crowfoot (*Ranunculus trichophyllus*) and teasel (*Dipsacus fullonum*).

2.3 Objectives of the monitoring programme

The ecological survey and monitoring programme was undertaken to ascertain the current ecological status of the wetland and to provide a baseline against which potential impacts can be measured and mitigated.

3.0 METHODS

The permanently established terrestrial and stream vegetation monitoring sites were relocated as closely as possible to the originals, using pacing and compass bearings to and from predefined landmarks. Due to the vegetation being very rank in most cases, only one of the wooden posts originally placed was found. This made relocating the exact position of the permanent quadrats difficult. An estimation of the positions was made from other landmarks and features. Vegetation was resurveyed in the terrestrial 2m X 2m permanent quadrats using

the Braun-Blanquet cover-abundance method and, in the case of the stream vegetation, the DAFOR scale was used, as in the original survey (Natura 1999). Sites were marked with a GPS 8-figure grid reference (Irish Grid; OS 1965) using a Garmin 12XL. Photographs were also taken at each quadrat. An extra quadrat was set up in Block 7 as there was only one quadrat present originally in this block. Data were entered into Excel and compared with the original vegetation data set using Sorenson's co-efficient of similarity (Magurran 1988; Table 2) Full quadrat data for 1999 and 2004 are presented in Appendix 3.

4.0 RESULTS

4.1 Vegetation sampling programme

Procedures were followed as laid out in 2.2.1 of this report and attempts made to relocate the permanent quadrats set out in 1999. Due to the vegetation being very rank in most cases, only one of the wooden posts originally placed was found. This made relocating the exact position of the permanent quadrats difficult. An estimation of the positions was made from other landmarks and features. GPS readings were taken at each quadrat site and are presented in Appendix 2. Sampling of the vegetation was repeated using the Braun-Blanquet and DAFOR scales for cover as in section 2.2.1. Full quadrat data are presented in Appendix 3.

Sorenson's co-efficient of similarity (Magurran 1988) was used to qualitatively compare the original vegetation data with that found in 2004. Results are shown in Table 1.

Table 1. Similarity (percentage) between 1999 and 2004 of fixed quadrats (1-14) and bank and stream quadrats (15-17).

Block	Quadrat no.	Similarity 2004
1	1	55
	2	50
3	5	60
3	6	77
4	8	33
5	9	62
	10	47
6	11	18
	12	47
	14	46
7	13	100
	15 stream	0
	15 bank	32
	16 stream	66
	16 bank	58
	17 stream	50
	17 bank	48

Results in Table 1 show the differences in the quadrats of the main blocks of the vegetation. Between 18-100% similarity was found with the previous survey results. Difficulty in relocating the exact fixed quadrat position exacerbated the differences between the 1999 and 2004 quadrats. Apart from that, some of the

wetter herbaceous species were not relocated in 2004 and this also accounts for some of the differences. As this may be a product of short-term weather fluctuations, this cannot be interpreted a meaningful change in the vegetation since 1999. Results from the hydrological data may further help to identify long term fluctuations in available moisture to these marshy grasslands. Results in Table 2 also show that the stream and bank vegetation showed quite large variation over the intervening time period with similarities of 0-66% with the previous survey. This is partly to do with some of the ditches having been cleared, but more to do with dropped water levels and the lack of grazing pressure on the banks.

4.2 Hedges/tree lines

Hedge lines were revisited within the site in 2004 and results of their re-evaluation are presented in Table 2. Hedgerows were still intact and providing good cover for birds and other wildlife. Many of the hedges have streams associated with them but now the water is much reduced or non-existent. Due to the lowered grazing pressure, many of the banks are now overgrown and somewhat rank or completely dominated by *Rubus*.

Table 2. Ecological evaluation of hedgerows in 1999 and 2004

Hedge no.	Local ecological Value (1999)	Comments in 1999	Revisited in 2004
H1	Moderate	Dense overgrown willow hedge with elder. Associated ditch. Good cover for birds	Hedge still present and unchanged.
H2	Moderate	Unmanaged hawthorn hedge >4m high with mature standard ash trees. Associated small stream flowing east. Shaded banks with woodland flora.	Hedge still present and unchanged. This hedge is not part of the existing NHA boundary, so could perhaps be dropped from any later surveys.
H3	Moderate	Overgrown hawthorn hedge >4m high with ash and sycamore trees and many climbing plants. Associated drainage ditch 2m wide with steep banks. Diverse ground flora.	This hedge spans two sides of the road and appears to be unchanged. There was no water in the streams at their base. There was a large dung heap close to the southern part of the hedge which may be polluting the stream.
H4	High	Unmanaged hawthorn hedge over a wide ditch. Mature ash trees. Good diversity of woody species. Associated ditch with shaded woodland flora, ivy and ferns. Good cover for wildlife.	This hedge is still intact with a variety of tree species still present. There may be more <i>Rubus</i> now, which is forming a wide band in front of the hedge. This is probably due to lack of grazing pressure on the site.
H5	High	Unmanaged mixed hedge along	This hedge is still present but

		a drainage ditch. Mature standard ash trees. Good diversity of shrubs and climbers. Associated ditch with flowing water. Steep banks with shaded ground flora	the flow of water in the ditch recorded in 1999 is non-existent now.
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4.3 Watercourses

The main difference between the current survey and that of 1999 is that water levels in 2004 are much lower in all the streams and drainage channels encountered on the site. This is more than likely due to the very dry weather that has occurred in 2003 and 2004. The short-term knock-on effect may be the temporary loss of some of the herbaceous wetland indicators. If this is a long-term, climatic change, then the site is under threat from drying out completely. The difficulty is separating out climatic effects from human induced changes such as increased drainage of the site through clearing of the existing drainage ditches or water abstraction.

4.4 Vegetation classification

Since 1999, *A Guide to the Habitats of Ireland* (Fossitt 2000) has been produced. Within this classification, several categories of habitat fit the descriptions of the vegetation within the site. For a large part of it, wet grassland (FS4) fits the description where *Juncus* spp., *Agrostis* spp., *Alopecurus* spp., *Poa trivialis*, *Cirsium palustre*, *Filipendula ulmaria*, *Mentha aquatica*, *Ranunculus flammula*, and *Galium palustre* are found. The defining factor is that grasses are >50%. Other parts are best described by reed and large sedge swamps (FS1), where *Phalaris* is dominant with few broadleaves e.g. Blocks 3 and 4. Some may also be described as freshwater marsh (GM1) with dominant *Juncus* spp., *Filipendula*, and *Agrostis stolonifera* as was found in Block 6. There is considerable overlap with some of these categories however and they don't adequately describe the plant communities within the habitats.

With regard to the NVC, MG 10 as described in 2.2.2, occurs many places on the site and is prevalent in Block 1 where there is still a moderate amount of grazing pressure. MG11 also occurs here where *Agrostis stolonifera*, *Festuca rubra* and *Potentilla anserina* are co-occurring (Appendix 3). However, because of the relaxed grazing over most of the site, several other NVC communities are also occurring. M23, which is an impeded *Juncus effusus* rush pasture with very few species present, is dominating much of Block 6 for instance. This may grade into MG 10 where soils become richer and more grazed (Rodwell 1992).

4.5 Rare plants

Only two of the plants mentioned in the 1999 review of rare plants on the site were refound, namely *Ranunculus sceleratus* and *Dipsacus fullonum*.

5.0 DISCUSSION OF RESULTS FROM 2004

The site appears to be drying out even further than in 1999. Many of the herbaceous wetland plant species found in the 1999 survey were not refound in 2004. This may be due to several factors;

- short-term or long-term climatic change, with the recent trend in increased summer temperatures and lower rainfall in the intervening period.
- local drainage - there was evidence of at least one drainage channel having been cleared in the 2004 visit. This activity will increase the amount of water lost from the site and will ultimately dry the site out even further.
- water abstraction which may be monitored through the piezometers placed on site. If water abstraction is having an effect on the site, this will be very difficult to separate this out from the previous factors mentioned.

Management does not seem to have changed much on site between 1999 and 2004 and the area is still sheep-, cattle- or horse-grazed as before. However, the intensity of the grazing seems to have reduced overall since 1999, with rank, unpalatable vegetation becoming more predominant. The vegetation analyses do not in general reflect the overall changes in the site. There is a lag period between the impact of a change in management and vegetation response to it. Long term hydrological data will clarify the wetland status of the site. This site would need to be managed in a more positive manner to bring it back to favourable status, given its local importance as one of the few marshy grasslands within County Dublin.

6.0 RECOMMENDATIONS FOR FUTURE MONITORING AFTER 2004

A number of minor improvements could be made for future monitoring of this site in terms of more adequately and accurately recording vegetation change to reflect change in hydrological status;

6.1 Photographs

All photos taken on the ground should be taken from fixed points and fixed bearings and labelled adequately for future reference. This aids in relocating the exact view at a later stage and to adequately record vegetation change at the landscape scale. Photos of quadrats should be taken from a designated corner of the quadrat.

Aerial photographs at a fixed scale should be taken in the same year and at the same time of year as the field monitoring for adequate reviewing of the gross changes in the vegetation. A suitable scale is 1:2500. An infra-red image would be preferable as it shows up vegetation type, density and water content more easily than in the visible range. These should be georectified for incorporation into the GIS and used to aid in mapping habitat boundaries.

6.2 Vegetation community recording

The perimeter of each block within the site should be walked and community types noted roughly on a map. Within the blocks, NVC classes would be preferable for defining communities and sub-communities as they are more detailed than those found in Fossitt (2000). The minimum area advised for mapping is 10m X 10m (0.01ha). Once communities have been defined, a full species list should be made within each community type and the DAFOR scale of abundance used for them. This gives a useful inventory of the community which may be used for descriptive purposes. At this point, at least two quadrats should be taken within each community and sub-community type present within each block. The quadrats should be placed in homogeneous vegetation representative of the stand. Mozaics of communities need to be indicated if patches are too small for mapping accurately and target notes made. The area of the community types needs to be mapped as accurately as possible. This can be done in the field, producing a hand-drawn map indicating where the community types are present and target notes as required. This can then be translated into the GIS with the aid of the aerial photos.

6.3 Quadrats

The number of quadrats taken is very important. It is recognised that at least two quadrats should be taken in homogeneous stands within each community (and sub-community) type within each block to reflect the range in variation found. As the vegetation is generally too high at this site for relocating wooden stakes, it is suggested that a GPS reading and a corresponding 'Waypoint' be taken at one designated corner of the quadrats. Waypoints may be downloaded directly into a GIS or entered into Excel. Given the accuracy of the GPS (circa 1-10m), the quadrat should be placed within a 10m radius of the vegetation boundary, to

reduce the risk of the GPS reading being taken in the wrong vegetation type at future monitoring times. Domin scale (Rodwell 1992), as well as the Braun-Blanquet scale, should be adopted for cover values within the quadrat to help match up more accurately with NVC categories.

Vegetation data may now be easily matched with NVC categories using MAVIS (www.ceh.ac.uk/products_services/software/mavis.htm) which is freely downloadable from the web, or MATCH (www.clues.abdn.ac.uk).

Other simple details may be recorded within each quadrat such as vegetation height. This can be done more objectively with a dropping plate c. 30cm in diameter and vegetation height noted beneath it using a metre stick or rigid tape measure. This is useful for monitoring changes in grazing pressure over time but only if monitoring is done within the same time period. Slope and aspect may also be important factors as is general soil type.

6.4 Geographical Information Systems (GIS)

Most of the above data can be incorporated into the GIS. Aerial photos may be used as a raster base as well as digital OS six-inch maps. Habitats and community types can be represented as polygons or lines with appropriate legends. Quadrat positions and photos may be embedded into the GIS using the GPS readings. Target notes can be included in point data on the map. Hydrological data can also be incorporated as a separate layer of information.

6.5 Costs and timing

There are some rough guidelines as to how long it takes to survey different habitats using NVC methodology in the UK (unpublished). These are outlined below in Table 3.

Table 3 Outline costs and timing for different habitats using NVC methodology

Habitat	Rate of survey Ha/day	Costs of survey £/ha
Coastal Cliff (roped)	3ha/day	130
Sand dunes	20ha/day	9.75
Heathland	25ha/day	7.80
Grassland	15ha/day	13.00
Woodland	25ha/day	7.80
Scrub	15ha/day	13.00
Mire (simple)	25ha/day	7.80
Mire (complex)	10ha/day	19.50

Relevant categories for this survey would be 'grassland' and 'mire'.

7.0 REFERENCES

- Anon. (1973). *A Preliminary Report on Areas of Scientific Interest in Co. Dublin*. Conservation & Amenity Advisory Service, Unpublished report. An Foras Forbartha. Dublin.
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- Fossitt J. 2000 *A Guide To Habitats In Ireland*. The Heritage Council.
- Magurran A.E. 1988 *Ecological Diversity and its Measurement*. Croom Helm.
- Natura (1999) *Bog of The Ring. Baseline Ecological Survey*. Wicklow Enterprise Centre. Wicklow, Ireland.
- Rodwell, J.S (ed.) (1992). *British Plant Communities. Volume 3. Grasslands and montane communities*. Cambridge University Press.

APPENDIX 1. Comparison of Blocks 1 – 7 between 1999 and 2004

Block	1999	2004
1	Damp marshy grassland growing on a peaty substrate. Vegetation is a mosaic of tall herbs and grasses; Iris, meadowsweet, Yorkshire fog and purple loosestrife. Grazed areas have a short sward of bent grass silverweed, common mouse-ear, glaucous sedge, white clover, meadow buttercup, red bartsia and ribwort plantain.	Little appears to have changed in the intervening period, except that it is less intensively grazed by the resident horses.
2	This is waste ground infilled with rubble and soil. It is now being partly recolonised by knotgrass, black medick, common poppy), fat hen, spear-leaved orache, white clover and red clover. The wetland species found include celery-leaved buttercup and a stonewort.	More topsoil is being placed on the existing spoil to raise the level even higher above the adjacent field (Block 1).
3	Marshy grassland on peat, which is drying out. The tall vegetation includes by soft rush and reed canary grass. Localised patches of Iris. Beneath the tall vegetation is a grassy sward of creeping bent grass, bottle sedge and brown sedge. Other common species include Yorkshire fog, silverweed, nettles and false-oat grass. There is no standing water.	On cursory inspection there is no significant change in this Block. The substrate was dry as before and probably due to the dry weather at this time of year. It is difficult to tell if the Block has dried out even further than before. Brown sedge (<i>Carex disticha</i>) appears to be doing well but is not flowering.
4	Marshy grassland dominated by rushes and tall grasses, notably soft rush, reed canary grass and Yorkshire fog. Locally there are large clumps of iris, meadowsweet, great willowherb, floating sweet-grass and nettle. Other wet species found are fen bedstraw, bittersweet, cuckoo flower, greater bird's foot-trefoil and marsh speedwell. Towards the west, the ground is slightly elevated, drier and more grassy, with false oat grass, Yorkshire fog and soft rush predominating.	This Block appears to be a lot drier than in 1999, but vegetation appears to be roughly the same. There are no damp or flooded areas as noted before in 1999 and the wet grassland indicators mentioned above such as <i>Glyceria</i> spp. and <i>Cardamine</i> were not found this time. This may however be due to the drier weather in recent summers and not a reflection of changed management.
5	Damp grassland which is drying out. The eastern end is characterised by rank grasses with cocksfoot, perennial rye-grass, false oat-grass and Yorkshire fog. This area has been managed, reseeded and grazed in the past, but is ungrazed at present. The main part of this block is colonised with thistles, hard rush and grasses including Yorkshire fog and false oat-grass. Hard rush generally replaces soft rush except towards the west end.	This block appears not to have changed much in the intervening period except that Iris seems to be more abundant than before, indicating perhaps that it has got wetter. It is now cattle-grazed rather than sheep-grazed.
6	Divided into two sections by a channel, it is dominated by soft rush. The northern section is drier and the grasses are false oat-grass, Yorkshire fog, meadow foxtail and reed canary grass. There are occasional clumps of iris. Other	This site seems to be much as it was in 1999. It is somewhat drier than before as many of the streams around its perimeter have dried up. Only the central stream dividing it had any

	herbaceous plants are meadowsweet and buttercup. The south is wetter and soft rush is dense and robust to over 1m high. There are also indicators of wetter conditions, with marsh willowherb, water horsetail, lesser spearwort and water starwort. Towards the southern edge the ground level rises and is drier with a grass dominated sward grazed by sheep.	water in it this visit, and that was very low and muddy. Soft rush is dominating most of the Northern half of the site and is very tall and dense. It is still cattle and sheep grazed but they seem to stay up on the higher ground mostly on the south side of the site.
7	Partly grazed by cattle. Marshy grassland similar to Block 6, dominated by soft rush and iris. Yorkshire fog is the most frequent grass with creeping bent, rough meadow and sweet vernal also. Other species include silverweed, marsh bedstraw, creeping buttercup and nettle. Near the road is an area of quaking ground. The northern edge slopes up to a strip of species-rich unimproved grassland with Yorkshire fog, sweet vernal-grass, crested dogs-tail, white and red clover, lesser stitchwort, birds-foot trefoil, ribwort plantain and hairy sedge.	Block 7 has not changed very much in appearance except the wet areas of quaking ground mentioned was not present this site visit.

APPENDIX 2. GPS grid references for permanent quadrats

Block	Quadrat number	Irish Grid Ref. 2004
1	1	IO 18459 59957
	2	IO 18408 59988
3	5	IO 17952 60050
	6	IO 17798 60094
4	7	IO 17651 60147
	8	IO 17560 60231
	16	IO 17691 60082
5	9	IO 17976 60159
	10	IO 17628 60327
	17	IO 17990 60179
6	11	IO 16957 60488
	12	IO 16886 60495
	14	IO 16822 60746
	15	IO 16764 60698
7	13	IO 16870 60805
	13b	IO 16822 60851

Appendix 3 Comparison of vegetation in quadrats 1-17 between 1999 and 2004

Year	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004
Quadrat no.	B1/ Q1	B1/ Q1	B1/ Q2	B1/ Q2	B3/ Q5	B3/ Q5	B3/ Q6	B3/ Q6	B4/ Q7	B4/ Q7	B4/ Q8	B4/ Q8	B5/ Q9	B5/ Q9	B5/ Q10	B5/ Q10	B6/ Q11	B6/ Q11	B6/ Q12	B6/ Q12	B7/ Q13	B7/ Q13	B6/ Q14	B6/ Q14
<i>Agrostis capillaris</i>																								
<i>Agrostis stolonifera</i>	3	2	4	3					3	2	2	2	2	2	3	2	2	2	3	2	1		2	1
<i>Alopecurus pratensis</i>									2										0.5	1	2	1	2	1
<i>Anthoxanthum odoratum</i>				0.5																				
<i>Arrhenatherum elatius</i>						0.5	2	1	2				0.5	1		1								
<i>Brachythecium rutabulum</i>				0.5																				
<i>Calystegia sepium</i>												0.5												
<i>Carex disticha</i>				1				2						0.5										
<i>Carex hirta</i>																0.5								
<i>Carex sp.</i>	2		1										0.5											
<i>Cerastium fontanum</i>		1	0.5	0.5									1	0.5		0.5			0.5					
<i>Cirsium arvense</i>			0.5						2				2	2	0.5									
<i>Cirsium palustre</i>			1										0.5	0.5		1		0.5						
<i>Cirsium vulgare</i>													1											
<i>Convolvulus arvensis</i>											4													
<i>Dactylis glomerata</i>													0.5											
<i>Epilobium hirsutum</i>															2	1								
<i>Epilobium palustre</i>																		0.5	0.5		0.5			
<i>Equisetum arvense</i>									0.5															
<i>Equisetum fluviatile</i>																			2					
<i>Equisetum palustre</i>									2				2	0.5		2	0.5							
<i>Festuca rubra</i>				2										0.5										
<i>Filipendula ulmaria</i>	2		1	1			1	1	2	3	2					0.5								
<i>Galium aparine</i>					0.5																			
<i>Galium palustre</i>																			1					
<i>Holcus lanatus</i>	2	3	2	2	2	0.5	5	4	2	4	3		3	2	2	3	3		3	2	2	3	3	3
<i>Holcus mollis</i>						1				2								1		1				
<i>Iris pseudacorus</i>	3	3	2	3						2				3	2	1								
<i>Juncus articulatus</i>				0.5																				
<i>Juncus effusus</i>					1	3					2				0.5	3		5	4	5		3	4	5

Lathyrus pratensis				0.5			0.5	0.5					1											
Lolium perenne	0.5			0.5			0.5						1	1										
Lythrum salicaria			1	1											0.5									
Mentha aquatica															0.5									
Moss																0.5		1		0.5				
Odontites verna	0.5		1	1																				
Phalaris arundinacea					5	5					1	5												
Plantago lanceolata				0.5																				
Plantago major			0.5																					
Poa trivialis	1	1	1		2		2	1	1		1		1		3	2			1		0.5		1	2
Polygonum sp.			2																					
Potentilla anserina	4	4		2			1	3					3	2										
Ranunculus acris	1		2										1		1									
Ranunculus flammula																	0.5							
Ranunculus repens		1		1					0.5				0.5		0.5	1								
Rumex acetosa							1	0.5										0.5						
Rumex conglomeratus															2									
Rumex obtusifolius															0.5									
Senecio jacobaea			1	1									1	0.5		0.5								
Stellaria media															0.5									
Stellaria uliginosa																		0.5						
Taraxacum officinale				0.5									0.5	0.5		0.5								
Trifolium repens	3		3	0.5										3	0.5	0.5								
Urtica dioica									1	0.5					0.5						2	0.5		
Vicia cracca																						0.5		
Vicia sepium																0.5								
Number of occurrences	11	7	16	20	5	5	8	8	8	8	8	4	18	14	17	17	5	6	12	5	7	5	5	5
No. of spp. In common		5		9		3		7		4		2		10		8		1		4		3		5
Co-efficient of similarity %		55.5		50		60		77.7		50		33.3		62.5		47.0		18.1		47.0		46.1		100
Year	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004	1999	2004
Quadrat no.	Q15	Q15	Q15	Q15	Q16	Q16	Q16	Q16	Q16	Q16	Q16	Q16	Q17	Q17	Q17	Q17	Q17	Q17	Q17	Q17	Q17	Q17	Q17	Q17
Type	Aquatic	Aquatic	Bank	Bank	Aquatic	Aquatic	Bank	Bank	Bank	Bank	Bank	Bank	Aquatic	Aquatic	Bank	Bank	Aquatic	Aquatic	Bank	Bank	Bank	Bank	Bank	Bank
Agrostis capillaris																								
Agrostis stolonifera	F																		F		O			

Alopecurus pratensis			R								R	
Angelica												R
Anthoxanthum odoratum												
Apium nodiflorum	O											
Arrhenatherum elatius			A				O	R				O
Bare ground												
Brachythecium rutabulum												
Callitriche sp.										O		
Calystegia sepium								F				
Carex disticha											R	R
Carex hirta												
Carex sp.												
Cerastium fontanum			O									R
Cirsium arvense				F			R				O	F
Cirsium palustris				O								R
Cirsium vulgare												
Convolvulus arvensis							O				F	
Crataegus monogyna				O								
Dactylis glomerata							O	O				O
Dipsacus fullonum							R					
Elymus repens							R					
Epilobium hirsutum					R	F	F	F				F
Epilobium palustre			R									
Equisetum arvense												
Equisetum fluviatile												
Equisetum palustre												
Festuca rubra											R	
Filipendula ulmaria											R	R
Galium aparine												R
Galium palustre												
Glyceria fluitans	O											
Hedera helix				O								
Heracleum Sphondylium							O					
Holcus lanatus			O	O			F	O				F
Holcus mollis								O				
Hypericum perforatum												R
Iris pseudacorus				O							R	O
Juncus articulatus												

Juncus effusus			O	O			O					
Lathyrus pratensis											R	R
Lemna minor									A	O		
Lolium perenne			R									F
Lythrum salicaria											O	
Mentha aquatica												
Moss											R	
Nasturtium officinale	O								D			
Odontites verna												O
Phalaris arundinacea				O	A	D		F				
Plantago lanceolata												
Plantago major												
Poa trivialis				O			R	O				O
Polygonum sp.												
Potentilla anserina												
Ranunculus acris												
Ranunculus flammula												
Ranunculus repens			F	F			F	O			O	
Rubus fruticosus agg.				F								
Rumex acetosa				O								
Rumex conglomeratus												
Rumex crispus				O								
Rumex obtusifolius							O					
Rumex sanguineus			F									
Senecio jacobaea			O	F							R	O
Sonchus asper												R
Sparganium erectum					O	F						
Stellaria media												
Stellaria sp.			O									
Stellaria uliginosa												
Taraxacum officinale												
Trifolium repens				F							R	F
Trifolium pratense				O								
Ulex europaeus				O								
Urtica dioica			R	O			O	A				
Veronica beccabunga	R				O							
Vicia cracca				O								
Vicia sepium												

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7/19/2007

Green crustose algae	O											
Number of occurrences	6	0	12	19	3	3	14	10	2	2	14	21
No. of spp. In common		0		5		2		7		1		8
Co-efficient of similarity %		0		32.25		66.66		58.33		50		48.48