

Clara Bog High Bog Ecological Survey



Survey commissioned by **National Parks and Wildlife Service.**

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EXECUTIVE SUMMARY

This survey, carried out in August and September 2009, aimed to assess potential changes in Clara Bog High Bog vegetation in the 2004 to 2009 period. Vegetation was described and mapped based on Raised Bog ecotope vegetation community complexes (Kelly, 1993). The following habitats described in Annex I of the European Habitats Directive (92/43EEC) were found: Active Raised Bog, Bog Woodland (both priority habitat), Degraded Raised Bog and Depressions on peat substrates of the Rhynchosporion.

Active Raised Bog covers 25.15% of the High Bog area. Clara West features the finest examples of this habitat consisting of *Sphagnum* hummocks, hollows, lawns and frequent pools. *Sphagnum* cover reaches 100% in certain locations.

Degraded Raised Bog covers 74.85% of the High Bog area. It was drier than Active Raised Bog and supported lower density of *Sphagnum* mosses. It also had poorer micro-topography where permanent pools and *Sphagnum* lawns were generally absent. Degraded Raised Bog at Clara Bog also includes some Dry Bog Woodland.

Depressions on peat substrates of the Rhynchosporion habitat was found in both Active and Degraded Raised Bog, but tended to be best developed and most stable in the wettest areas of Active Raised Bog. Clara West also contains good examples of Bog Woodland habitat dominated by Birch with a high cover of *Sphagnum* mosses.

The area of Active Raised Bog habitat has slightly increased (11.16ha, 11.12% of the High Bog) in both Clara West and East in the 2004 to 2009 period. This increase is the result of expansion and/or regeneration of active peat forming vegetation, brought about by restoration work. The improvement of ecotope boundaries due to more accurate mapping in the 2009 survey may have also played a role in this increase. This improvement in mapping has shown links between active peat forming areas previously mapped as being isolated. Re-allocation of some sections of previously mapped Active Raised Bog habitat to Degraded Raised Bog has also resulted in changes in the distribution and extent of Active Raised Bog habitat.

Ongoing subsidence associated with peat cutting and cutover drains along the southern section of Clara West has caused the expansion of Active Raised Bog habitat in lower areas and further drying out process in higher areas. This has resulted in the expansion of Degraded Raised Bog habitat (i.e. expansion of drier mounds and ridges).

Overall, restoration works at Clara are considered to have had a positive effect on the Active Raised Bog habitat. This improvement is happening despite ongoing negative impacts caused by drainage and peat cutting particularly along the southern section of the bog, as well as repetitive fires. However, the damaging nature of these negative activities should not be under estimated as they may lead to irreversible losses of Active Raised Bog habitat at Clara Bog.

1. SITE IDENTIFICATION

SAC Site Code	000572	6" Sheet:	OF: 7 & 8
Grid Reference:	N 305 245	1:50,000 Sheet:	48
High Bog area (ha)¹:	443.21 (Total)	246.78 (Clara West)	196.43 (Clara East)
Date of Visit:	24 to 27/08/09 and 31/08/09 to 02/10/09		
Townlands:	Doory, Derries, Ballina, Bahernagrisna, Clogher, Bawn, Ballinough, Erry.		

2. SITE LOCATION

Clara Bog is situated 2km south of Clara village and is split into two by the Clara-Rahan road running NNW-SSE through the site. Clara is the largest remaining example of the true Midland Raised Bog sub-type in Ireland (Cross, 1990).

3. DESCRIPTION OF THE SURVEY

The survey, commissioned by National Parks and Wildlife Service (NPWS), was carried out during August and September 2009 and involved a vegetation survey of the High Bog at Clara Bog. Similar surveys were carried out on Clara bog in 1993 by Kelly *et al.* (1995) and 2004 by Fernandez *et al.* (2005). High Bog vegetation was described and mapped based on Raised Bog ecotope vegetation community complexes developed by Kelly *et al.* (1995), these complexes are explained in Appendix I. Detailed notes were taken on each community complex and any flushed or soak areas that were present. These included: species lists; estimation of % cover of dominant species; percentage *Sphagnum* cover; evidence of damage (due to burning, grazing or drainage); micro-topography; ground firmness; and presence of *Cladonia* species. A list of photographic records is given in Appendix II. The survey aimed to assess potential changes in High Bog vegetation. This survey is part of the NPWS Monitoring Programme on the assessment of changes in Annex I habitats within the Habitats Directive (Council Directive 92/43/EEC).

The entire High Bog of both Clara West and East was re-surveyed, although sections mapped as sub-marginal, sub-central and central ecotope in 2004 were surveyed in more detail. These are the areas where changes were likely to have occurred. Quadrats recorded in the 2004 project (Fernandez *et al.* 2005) were re-surveyed and additional quadrats were recorded when considered necessary (see Appendix III). The size of quadrats used was 2m x 2m.

A GeoExplorer handheld GPS minicomputer (Trimble GeoXT) was used in the field to record quadrats, ecotope boundaries, location of vegetation complexes and other points of interest.

The GPS positions of these features were logged and stored on Terrasync software (Trimble). Additional comments were stored as text fields in the device. Post processing of data was carried out, based on the Active GPS Network from Ordnance Survey Ireland, to obtain sub-metre accuracy of the data.

A digital vector format ecotope vegetation map was produced based on the spatial data collected during the survey using ArcGIS 9.3 and 2005 aerial photography. The Irish National Grid was used as the co-ordinate reference system. Ecotope boundaries, recorded during this study, correspond as closely as possible to boundaries in the field. Vegetation complex and ecotope maps are given in Appendix IV.

4. DESCRIPTION OF THE HIGH BOG

Clara Bog is bounded in the north by esker ridges running in a NW to SE direction. There are some excellent examples of esker grasslands (some of which are orchid-rich) included within the SAC (O'Mahony, draft). To the east there is a transition to calcareous woodland and to the south there is a large area of bog that has been cutaway over the last number of centuries. Previously, the southern extent of raised bog peat at this site was recorded as being the edge of the Silver River (van Tatenhove and van der Meer, 1990).

In geomorphologic terms Clara Bog can be classed as a Ridge River type bog (Kelly *et al.*, 1995). The bog is believed to once have had a central dome shape. However, the construction of a road (Clara-Rahan road) running through the bog has caused subsidence of up to 10m adjacent to the road and approximately 2m in the centre of Clara Bog West (van der Schaaf, 2002). The bog now consists of two shallow domes (Clara Bog East and Clara Bog West) which slope towards the road (Bell, 1991). In addition, there has been a relatively large subsidence (4-5m) around Shanley's Lough in Clara West. It is believed that this occurred due to the presence of a large till mound to the west of this area (van der Schaaf, 2002). This mound is thought to have had a former surface position approximately equal to that of the surrounding bog, after subsidence occurred, this mound acted as a barrier to acrotelm flow towards the area around Shanley's Lough. The area dried out, (consequently increasing the subsidence) until the surface area was eventually low enough to attract flow from other parts of Clara West, along a long flow path around the northern and maybe also the southern end of the western mound (van der Schaaf, 2002). This together with the infilling of the drains in the area caused a re-wetting of the area resulting in renewed peat growth (van der Schaaf, 2002).

¹ Based on 2005 OSi Aerial photography.

The average subsidence on Clara Bog West between 1982 and 1991 was recorded as 2cm/yr, indicating that the road is probably still affecting the surface levels on Clara West (van der Schaaf, 2002). Furthermore, the deep drainage system (with drain levels of about 6m below the bog surface) excavated in the cutaway to the south of Shanley's Lough, is causing considerable subsidence in the bog area between Shanley's Lough and the southern margin (van der Schaaf, 2002). This drainage, combined with peat extraction, appears to have resulted in a change in the hydrology of Shanley's Lough soak area. The average subsidence on Clara Bog East between 1982 and 1991 was recorded as 4cm/yr. The higher subsidence on Clara East during this period can be attributed to the drainage system that was established there in 1983.

Most of the peat cutting on Clara has taken place in the south of the site. The area around Shanley's Lough is now believed to be the main discharge point for much of Clara West (van der Schaaf, 2002). The absence of a clear dome shape causes relatively long flow paths without large gradients (van der Schaaf, 2002). In addition, the soak system in the area around Shanley's Lough acts as a reservoir and thus outflow from Clara Bog West can continue for a considerable period of time after periods of precipitation (van der Schaaf, 2002).

5. ECOLOGICAL INFORMATION

5.1. Raised Bog Annex I (Habitats Directive (92/43/EEC)) habitats

The following Raised Bog EU Annex I habitats, are found in Clara Bog;

Bog Woodland (EU code 91D0),

Active Raised Bog (EU code 7110),

Degraded Bog (EU code 7120) and

Depressions on peat substrates of the Rhynchosporion (EU code 7150).

5.1.1. Active Raised Bog (7110)

The current area of Active Raised Bog at Clara Bog is 111.49ha (25.15% of the High Bog) as follows: Clara West 79.89ha and Clara East 31.6ha.

Clara is recognised as having the finest example of soak systems remaining in Ireland as well as having well-developed hummock and hollow complexes (Cross, 1990). The Active Raised Bog habitat at Clara includes central and sub-central ecotope, as well as, active flush and soaks systems, including Bog Woodland.

Central ecotope was found in both Clara East and Clara West at twenty locations (**C1 to C20**) and the extent of this central ecotope varies from 0.01ha to 2.6ha. Clara West contains the largest extent and number of central ecotope examples. Clara West features the finest examples of Active Raised Bog consisting of hummocks, hollows, lawns and frequent pools (Vegetation community complex 14). Inter-connected pools, that cover more than 50% of the ground in places, are mostly infilled with *Sphagnum cuspidatum* and support Bog Bean (*Menyanthes trifoliata*), Great Sundew (*Drosera anglica*) and Common Cottongrass (*Eriophorum angustifolium*). Large *Sphagnum papillosum* and *S. magellanicum* hummocks surround the pools. Ling Heather (*Calluna vulgaris*) and Cross-leaved Heath (*Erica tetralix*) are very frequent; other species present include Hare's-tail Cottongrass (*Eriophorum vaginatum*), White Beak-sedge (*Rhynchospora alba*), Bog Asphodel (*Narthecium ossifragum*), Round-leaved Sundew (*Drosera rotundifolia*) and Cranberry (*Vaccinium oxycoccos*). *Sphagnum* cover is generally greater than 70% and reaches 100% in places. *S. papillosum*, *S. magellanicum* lawns are also frequent. Hummocks of *S. imbricatum* and *S. fuscum* are also found in these areas. Vegetation community complex 15 is also recorded in Clara West (Hummock / hollow scattered pool complex; Appendix I). A less developed central ecotope type (complex 10/15) is found in both sections of Clara (West and East). Pools cover decreases in these areas, but the overall *Sphagnum* cover is very high (up to 100% in places) and *Sphagnum magellanicum* and *S. papillosum* lawns are common.

Central and sub-central ecotope areas are often found in close association with flush/soak systems such as **C5**, **C6** and **C10** in Clara West and **C14**, **C15** and **16** in Clara East. The presence of Bog Rosemary, Cranberry, *Polytrichum* spp. and Crowberry (*Empetrum nigrum*) within some of these sections (e.g. **Sc23**) indicate that these areas are transitional. In the sub-central ecotope, pools and *Sphagnum* lawns become less frequent, as does *S. cuspidatum*. Conversely, *Sphagnum magellanicum* becomes more abundant. *Sphagnum* cover is generally lower within this ecotope and hummocks and hollows dominate the micro-topography. Some of the poorer quality sub-central areas have no pools and are dominated by Ling Heather and Hare's-tail Cottongrass. These areas have only a moderate (40-50%) cover of *Sphagnum* species composed mostly of *S. capillifolium* and *S. magellanicum*.

There are two main areas of flush/soak habitat in Clara West (**F1** & **F2**; see Appendix IV, Map 1). Parts of these soaks are extremely wet with open water present in places (**F2**). These soak systems are diverse with areas of wet scrub, wet woodland and central-like-ecotope all present. Lough Roe (**F6**) is the main flush/soak system of interest in Clara Bog East. It is the only known floating raft of alkaline vegetation on a Raised Bog and is species rich (O'Mahony, draft). The existence of Lough Roe was one of the main reasons given for conserving Clara Bog in the mid-1980s. It is a relict feature and is in transition from being influenced by minerotrophic conditions to being influenced by more ombrotrophic conditions (Kelly and Schouten, 2002). A smaller soak is seen to the south of Lough Roe (**F8**). This is thought to have developed in a similar fashion to Lough Roe, but has made the transition from minerotrophic to ombrotrophic vegetation more rapidly, probably due to its smaller size and closer proximity to the road (Kelly and Schouten, 2002). There are also numerous in-filling pools found scattered around the north-eastern portion of Clara East which, can essentially be considered as active soaks. These pools are visible on the 1910 six inch map. The majority of these pools are infilled with excellent cover of *Sphagnum*, only some of them have open water present.

5.1.2. Degraded Raised Bog (7120)

The current area of Degraded Raised Bog at Clara Bog is 331.87ha (74.85% of the High Bog) as follows: Clara West 167.01ha and Clara East 164.86ha.

Degraded Raised Bog includes the face-bank, marginal and sub-marginal ecotopes as well as inactive flushes including Dry Bog Woodland. Although some areas of Degraded Raised Bog have a relatively well-developed Raised Bog flora, they are affected by water loss to varying degrees, and are usually devoid of permanent pools.

Sub-marginal ecotope features the most developed micro-topography within Degraded Raised Bog, with higher presence of hummocks and hollows and *Sphagnum* cover (up to 30%). *Sphagnum* cover mostly consists of *S. capillifolium*. *Sphagnum papillosum*, *S.*

tenellum, *S. cuspidatum* and *S. subnitens* are also present. Very occasionally *S. imbricatum* and *S. fuscum* hummocks are found. Ling Heather, Hare's-tail Cottongrass and Common Cottongrass, as well as, frequent patches of Bog Asphodel and Carnation sedge (*Carex panicea*) dominate the vegetation.

Marginal ecotope is slightly drier than marginal ecotope and covers large sections of High Bog particularly at the edges. Micro-topography consists of low hummocks, flats and very occasionally hollows. The *Sphagnum* cover is even lower here than in the sub-marginal ecotope (<10%) and the vegetation is dominated by Carnation sedge, Bog Asphodel and Deergrass (*Trichophorum cespitosum*).

Face-bank ecotope is characterised by firm ground, tall Ling Heather, poor *Sphagnum* cover and flat micro-topography. Hollows and hummocks are very occasionally found. Subsidence, from drainage, caused by the construction of the road and peat cutting has resulted in the presence of mounds or ridges, raised from the surrounding High Bog expanse in both Clara West and East. These mounds are generally dominated by marginal ecotope consisting of dry robust Ling Heather and have little or no *Sphagnum* cover.

Small inactive flushes are also scattered across Clara Bog. There are also three areas of Dry Bog Woodland on Clara West. They have low *Sphagnum* cover and are not considered to be active peat forming systems. **DBW1** was found on a low ridge (1-2m) within Flush 1. Downy Birch (*Betula pubescens*) trees and saplings (1-6m high) are scattered over the ridge, which is dominated by tall Ling Heather (1m high) growing over hummocks of *Sphagnum capillifolium*, *S. papillosum* and *Aulacomnium palustre*. Purple Moor-grass (*Molinia caerulea*) scattered Bog Myrtle (*Myrica gale*) and Bramble (*Rubus fruticosus*) occur on top of the ridge. Two further Birch copses (**DBW2** & **DBW3**) are found in the south of flush 2.

5.1.3. Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchosporion vegetation is widespread on Clara (West and East). It is found in both Active and Degraded Raised Bog, but tends to be best developed and most stable in the wettest areas of Active Raised Bog. In these areas, the Rhynchosporion vegetation occurs along pool edges and on flats underlain by deep, wet and quaking peat. Typical plant species include White Beak-sedge, *Sphagnum cuspidatum*, *S. auriculatum*, Bog Bean and Common Cottongrass. Brown Beak-sedge (*Rhynchospora fusca*) is also present in Clara Bog. This species appears to be associated with the species-poor shallow pools and hollows in the marginal areas of the bog (Kelly and Schouten, 2002).

5.1.4. Bog Woodland (91D0)

Clara West still contains good examples of Bog Woodland habitat. The current area in Clara West is estimated to be approximately 1.38ha (0.56% of High Bog). Bog woodland is found in three locations in Clara West (**BW1**, **BW2** and **BW3**). Each patch of bog woodland is found associated with the flush/soak systems on the High Bog. Bog Woodland was not comprehensively recorded in the 2009 survey; however, it is evident that the extent of Bog Woodland at Clara Bog remains similar to that reported in 2004.

5.2. Detailed vegetation description of the High Bog

The following vegetation description was recorded during the 2009 survey of Clara Bog. Vegetation is divided into a number of community complexes, which are listed and described based on the dominant species. These community complexes are grouped into ecotope types. The distribution of the ecotopes is shown on the ecotope map (Appendix IV, Map 1). The community complexes are shown on the community complex map (Appendix IV, Map 2).

5.2.1. Active Raised Bog

Central Ecotope Complexes

Complex 14

This complex was found at several locations on Clara West (**C3**, **4**, **5**, **6**, **10**, **11** and **12**).

C3 remains very wet with quaking ground underfoot. Micro-topography consists of large interconnected pools (70% cover), containing White Beak-sedge, *Sphagnum cuspidatum* lawns and open water. Large *Sphagnum papillosum* and *S. magellanicum* hummocks surround the pools. Ling Heather and Cross-leaved Heath are very frequent; other species present include Hare's-tail Cottongrass, Common Cottongrass, Great Sundew and Round-leaved Sundew. Algae is absent. Quadrats **Qc1** and **Qc3** were recorded within this complex. The location of this complex is shown in Map 2 (Appendix IV) and the quadrat details are given in Appendix III. A large open water pond has developed to the northwest of **C3** (GR: 224196, 230334; see photograph 1).

C4 was found to the east of Clara West (GR: 224543/230374). It appears to be a flat quaking area with a high *Sphagnum* cover that is generally more than 80%. The micro-topography consists of low hummocks and inter-connecting pools that grade into *Sphagnum* lawns. *Sphagnum papillosum* (approx. 25%) and *S. magellanicum* (approx. 25% cover overall) form a thick layer and blanket the vegetation in the lawn areas. These areas are dominated by White Beak-sedge; Bog Asphodel is also present. *Aulacomnium palustre* is also found scattered amongst the lawns of *Sphagnum*. In the south of this complex, the pools are not easily distinguished from the lawns, with very little open water present. *Sphagnum*

cuspidatum (approx. 30% cover overall) dominates the pools with Bog Bean and Great Sundew also being present. Towards the centre and north (GR: 224544/230468) of this complex the pools are more well defined and cover more than 50% of the area. *Sphagnum cuspidatum* cover is more than 50% in this area and *Sphagnum lawns* are less frequent. Common Cottongrass is present and Bog Bean is less frequent or absent. White Beak-sedge dominates the edges of the pools. Hummocks are mainly of *S. capillifolium*, though *S. imbricatum* is also present. Low-growing (<0.2m) Ling Heather and Cross-leaved Heath are found on the hummocks ranging from 10-20%. Cover of *Cladonia* spp. is patchy on the hummocks.

C5 was found amongst flush vegetation to the east of the mineral mound in the area of Shanley's Lough. The area is quaking and is dominated by large pools, which cover more than half of the area. These pools are covered with a thick layer of *Sphagnum cuspidatum* with the overall *Sphagnum* cover approaching 100%. Common Cottongrass and Bog Bean are also present in the pools. Hare's-tail Cottongrass is present on low hummocks. Ling Heather (0.3-0.5m) cover is low and was found scattered throughout the vegetation usually on the taller hummocks. Bog Asphodel occasionally occurs in dense patches at the edges of pools, while lawns of *Sphagnum magellanicum* are also found in places, particularly where the central ecotope complex grades into the sub-central complex 9/10. Saplings (up to 1.5m) of Downy Birch are found scattered throughout the area. There are also indications of flushes in the area with the presence of Cranberry, *Aulacomnium palustre*, *Polytrichum* sp. and *Sphagnum recurvum*. Bog Rosemary (*Andromeda polifolia*) is also present. Bog Myrtle and Purple Moor-grass are found near the adjacent flush (**F2**).

C11 - This central ecotope area, located to the south of Clara West, also consists of complex 14. The shape has been slightly modified due to an improvement in mapping in the 2009 survey; however, the vegetation remains similar to that described in the 2004 survey. Large inter-connected *Sphagnum cuspidatum* pools and *S. magellanicum* lawns characterise this complex. Other species include White Beak-sedge, Great Sundew and Common Cottongrass.

C12 - This example of central ecotope still contains a small flush/soak area (**F17**). The vegetation in **C12** remains similar to that described in the 2004 survey. Quadrat **Qc2** was recorded within **C12**.

Complex 15

This complex was found in several locations on Clara West (**C2, 3, 8, 9 and 18**).

C2 - This is essentially a pool filled with *Sphagnum cuspidatum* (cover up to 100%). Sub-central ecotope (complex 9/7/10) surrounds **C2**. This area appears to be flushed, reflected in the presence of Cranberry, *Aulacomnium palustre*, tall Ling Heather (0.4-0.5m) and tufts of Hare's-tail Cottongrass.

C9 was found in a small area close to the centre of Clara West. This area has a very well developed micro-topography with tall hummocks, hollows and pools. The pools cover 15-20% of the surface area, but are mostly open water with only a very patchy and thin cover of *Sphagnum cuspidatum* present. The surface is very soft underfoot and is quaking in places. The overall *Sphagnum* cover is 40-60% consisting of *S. cuspidatum* (5-10%), small lawns of *S. magellanicum* (15-20%), *S. papillosum* (15-20%) and hummocks of *S. capillifolium* (10%). Ling Heather (0.3-0.5m) dominates on hummocks (20-30%) along with Hare's-tail Cottongrass (5-10%), which becomes more prominent as the area grades into sub-central ecotope. White Beak-sedge is prominent at the edge of most pools. Quadrat **Qc6** was recorded within this section of central ecotope. **C9** was allocated to complex 14 in the 2004 survey; however it was described as having low pool cover. Therefore, this area corresponds to complex 15 instead of 14.

C18 – This small area of complex 15 is located within **Sc6** to the north of Clara West. Pools become frequent and ground is quaking underfoot. *Sphagnum* cover increases in comparison to the surrounding sub-central ecotope (complex 9/7/10 and 9/7/10+P).

Complex 10/15

This complex was found in several locations on Clara West (**C1, 5 and 8**) and on Clara East (**C14, 15, 16, 17, 19 and 20**).

C1 - This complex was found to the north of Clara West (GR: 224116/230634). This area appears to be a small depression and the micro-topography is dominated by hummocks, lawns and pools with the pools covering up to 30-40% of the surface area (the complex shows characteristics of Complex 15 in places). *Sphagnum cuspidatum*/Common Cottongrass type pools cover 10-20% of the surface area and *Sphagnum cuspidatum*/*S. magellanicum* type pools/lawns cover 20-30% of the surface area. There is, in general, a very thick *Sphagnum* layer and the overall *Sphagnum* cover is estimated to be 80-100% with *S. cuspidatum* accounting for 30-40%, *S. magellanicum* for 20-30%, *S. papillosum* for 10-20% and *S. capillifolium* for 10-20%. Towards the edges of this complex, the cover of *S. cuspidatum* decreases and that of *S. magellanicum* increases as the area grades into the sub-central complex 10/9. The overall cover of Hare's-tail Cottongrass (5%) also increases

towards the edges of this complex. Other prominent species include White Beak-sedge (5-10%) and Ling Heather (10%). Quadrat, **Qc4** was taken within this complex.

C8 - This complex was found close to the centre of Clara West to the northwest of the mound and immediately north of an open water pond (GR: 223975/230042). The surface is quaking and the *Sphagnum* cover in general is greater than 80%. Thick lawns of *S. magellanicum* and *S. papillosum* and pools, covered with a thick layer of *S. cuspidatum* dominate in this area covering about 75% of the surface. Tussocks of Hare's-tail Cottongrass (10-20% cover) along with Ling Heather (0.3-0.5m) dominate the vegetation. White Beak-sedge and Bog Asphodel are present at low cover values (<5%). Towards the north of this area of central ecotope, the micro-topography becomes better developed with taller hummocks and more well-defined pools so that the area conforms more to the Central Complex 15. This area is also quaking with pools covering 25-30% of the surface area. These pools are filled with a thick layer of *Sphagnum cuspidatum*, although *S. magellanicum* dominates in places. The hummocks are mainly of *S. capillifolium* and *S. imbricatum* is also present. White Beak-sedge (10-20%) is more prominent in this area as is Ling Heather (<0.3m), and the cover of Hare's-tail Cottongrass is lower (5-10%). Further north again, the pool cover decreases so that this central complex grades into the sub-central complex 4/10, reflected by the dominance of *Sphagnum magellanicum* over *S. cuspidatum* and the increase in cover of White Beak-sedge. The overall *Sphagnum* cover is still quite high (>50%).

C14 - located in Clara East was found to be slightly smaller than when surveyed in 2004. However, only one dot was recorded for this complex type in this location in the 2004 survey and the original extent was likely to be overestimated. Quadrat **Qc5** was recorded within **C14**. An additional quadrat (**Qsm1**) was recorded in 2009 in the area formerly mapped as central ecotope within **C14**.

C15 also consists of complex 10/15 and was found within **Sc24**. Micro-topography consists of *Sphagnum magellanicum* and *S. capillifolium* hummocks and large *S. magellanicum* lawns. **C15** remains similar to the description given in 2004 under in-filling pools (soaks). This area of central ecotope is located 25m to the southwest of the original (2004) location. The area was surveyed more accurately in 2009 and therefore this discrepancy is likely to be due to mapping error in 2004.

C19 corresponds to a small section of central ecotope found in the centre of **Sc16**. Here, *Sphagnum* cover reaches 90%, mainly consisting of *S. papillosum*/*S. magellanicum* lawns with Great Sundew and White Beak-sedge (20% cover). Ground is quaking underfoot. **Sc16** was described in 2004 as containing a small section of very wet ground, high *Sphagnum* cover and well developed micro-topography. Therefore **C19** may have been already present in 2004.

C20 - This area of complex 10/15 was found within **Sc24**. Complex 10/9 and 7/9+P were recorded here in 2004, this indicates that the vegetation complex may have changed since the last survey.

Sub-Central Ecotope Complexes

Complex 10/15-

This is a much poorer version (i.e. lower *Sphagnum* cover, poorer micro-topography) of central complex 10/15, found to the southeast of Clara East, dominating **Sc14**. This section of sub-central ecotope remains very similar to the description given in 2004. Quadrat **Qsc11** was taken within Complex 10/15-. Open water, *Sphagnum cuspidatum* dominated inter-connected pools are frequent. *Sphagnum papillosum*, *S. capillifolium* and *S. imbricatum* hummocks are present. Overall *Sphagnum* cover is 50% and the micro-topography is rather flat despite the presence of pools and hummocks. Tall Ling Heather and Cross-leaved Heath (50-60%), Hare's-tail Cottongrass (10%), Common Cottongrass (<5%) and Bog Asphodel (5%) dominate the vegetation. *Cladonia* spp. cover is 5 to 10%.

Complex 9/10

This complex was found within five different sections of sub-central ecotope on Clara Bog: **Sc1, 7, 8 and 17** on Clara West and **Sc12** on Clara East.

Complex 9/10 was found within **Sc8** to the east of Clara West (GR: 224489/230484) surrounding the area of central ecotope **C4**. The ground is very soft underfoot and the micro-topography is poorly developed. The vegetation is dominated by Hare's-tail Cottongrass and Common Cottongrass (with an average combined cover of 30-40%). The total *Sphagnum* cover is 40-60%; it patchy in places and it does not form a thick blanket, except where the complex grades into central ecotope. The pool cover is 5-10% and these pools, which are small, have only a partial cover of *Sphagnum cuspidatum* with open water common. Common Cottongrass and White Beak-sedge (20% cover) dominate the vegetation around the pools. Ling Heather (0.2-0.3m in height) and Cross-leaved Heath occur at an average combined cover of 25% and Bog Asphodel at 10%. Hummocks of *Sphagnum capillifolium* dominate the *Sphagnum* layer though lawns of *S. magellanicum* become more common as the complex grades into central ecotope. Quadrat **Qsc3** was recorded within **Sc8**.

Sc17 – This corresponds to a small slightly depressed section of sub-central ecotope to the south east of Clara West (GR: 224505/229908). This new area of sub-central ecotope surrounding drain D7 was likely to have been missed during the 2004 survey. Complex 9/10 in this location is characterised by very soft to quaking ground. Ling Heather and Cross-leaved Heath, which height is less than 0.3m, dominate (40% cover). Hare's-tail Cottongrass reaches 30% cover. Accompanying species include: Bog Asphodel (5%), White Beak-sedge (<5% cover), Deergrass (1%), Carnation sedge (1%), Common Cottongrass, Bog Rosemary, Cranberry, Great Sundew and Round-leaved Sundew. *Cladonia* spp. cover is less than 1%. Micro-topography consists of low hummocks, hollows, *Sphagnum* lawns and poorly developed pools. *Sphagnum* cover ranges from 70 to 80%; *S. magellanicum* (dominating

lawns, 30% cover), *S. papillosum* (25%), *S. capillifolium* and *S. cuspidatum* in hollows and shallow pools.

Complex 9/10 was also found within **Sc1** between the mound and the area of central ecotope (**C5**) towards the south of Clara West (GR: 223952/230083). The ground is soft underfoot and there are hummocks/hollows, lawns and shallow pools. The *Sphagnum* cover averages at 50% cover (increasing towards the central ecotope), and is dominated by lawns of *S. magellanicum* and shallow pools of *S. cuspidatum*. Tussocks of Hare's-tail Cottongrass (approx. 10% cover though much higher in places) characterise the vegetation along with a robust growth of Ling Heather (0.4-0.5m) that occurs at approximately 25-30% cover. White Beak-sedge and Bog Asphodel occur at the edge of the lawns and pools but are found at a low cover value (5%). *Aulacomnium palustre* and Cranberry are also present. Towards the east where the *Sphagnum* cover increases this complex was named **complex 10/9** and towards the west, where it decreases it was named **complex 9/7/10**.

Complex 10/9

This complex has a slightly higher *Sphagnum* cover than 9/10 and was found in several sections of sub-central ecotope on Clara Bog: **Sc1** on Clara West and **Sc10-16, 21, 22, 24-27, 30, 31** and **35** on Clara East.

Sc10 - This sub-central ecotope section is located to the north of **F6**, mostly consists of complex 10/9. The 2009 survey map shows that **Sc10** is linked to **F6**. Common Cottongrass cover is higher than Hare's-tail Cottongrass cover and *Sphagnum magellanicum* lawns dominate the moss layer. **Sc10** seems to be expanding towards the southwest of the site.

Sc13 - Complex 10/9 dominates **Sc13** to the south of **F9**. A series of blocked drains meet in this location. Although slightly larger than previously mapped in 2004, no major changes were noted. More accurate mapping in the 2009 survey is likely to justify this slight change in size. Quadrat **Qsc12** was recorded within **Sc13**. Hummocks and open water hollows/pools are present within this complex. *Sphagnum magellanicum*, *S. papillosum* lawns are also present. Overall *Sphagnum* cover is 60% and the eastern section of **Sc13** is waterlogged. Patches of sub-marginal ecotope are also present within **Sc13**.

Sc15 - This section of sub-central ecotope mostly consists of complex 10/9. The northern section of **Sc15** was found to be connected to **F12**, which, is also linked to **F11** and **F6** (Lough Roe) to the north. Micro-topography consists of *Sphagnum papillosum*, *S. magellanicum* hummocks and *S. cuspidatum* hollows. Ground is generally very soft and the *Sphagnum* cover reaches 70-80%. Hare's-tail Cottongrass (30-40%), Ling Heather and Cross-leaved Heath (20-30%) dominate the complex. Common Cottongrass, Bog Asphodel, Round-leaved Sundew and Bog Rosemary are also present.

Complex 10/9 dominates **Sc16**, which also features a small section of central ecotope (complex 10/15). Although **Sc16** was recorded as being smaller in the 2009 survey than in the

2004 survey, this change in ecotope extent is likely to be the result of more accurate mapping in the present survey, rather than any actual change in vegetation.

Complex 10/9 dominates large sections of the newly mapped **Sc22**. *Sphagnum papillosum* and *S. magellanicum* lawns are common. The area is slightly depressed but a gentle slope towards the west was noted.

Complex 10/9 characterises **Sc25** (GR: 225284/230404). This area is located amongst a series of blocked drains and is likely to have developed in the recent past. Ground is soft and slightly depressed. Hare's-tail Cottongrass (60%), Ling Heather and Cross-leaved Heath (5%) dominate the complex. *Sphagnum* cover (70-80%) is high and consists mostly of *S. papillosum* and *S. magellanicum* lawns. Common Cottongrass and Bog Rosemary are also present. Micro-topography consists of hummocks and lawns.

A new area of sub-central ecotope (**Sc26**) consisting of complex 10/9 was found to the southeast of Clara East, where two blocked drains meet. Although patches of sub-marginal ecotope are also present, the ground is overall very wet and waterlogged in places. Hare's-tail Cottongrass (40-50%), Ling Heather and Cross-leaved Heath (20%) dominate the vegetation. Micro-topography consists of *Sphagnum papillosum*, *S. magellanicum*, *S. capillifolium* hummocks and *S. cuspidatum* open water hollows/pools. The area is slightly depressed and the ground is very soft. *Sphagnum* cover reaches 60%.

Sc30 - This section of sub-central ecotope was previously mapped as part of a larger area (**Sc11**). Complex 10/9a dominates **Sc30**, and this complex is characterised by a higher percentage of Common Cottongrass which replaces Hare's-tail Cottongrass and becomes dominant. A similar vegetation description was given for this area in 2004.

Complex 4/10

This complex was found within five different sections of sub-central ecotope on Clara west **Sc1, 2, 8, 18** and **19**.

This complex was found in the northeast of Clara West (GR: 224652/230663) and has been named **Sc18**. The surface is very soft underfoot and the *Sphagnum* cover averages at 40-50%, but is patchy in places. The micro-topography is poorly developed with low hummocks and hollows occurring, but no pools. Hummocks of *S. capillifolium* dominate the *Sphagnum* layer along with *S. papillosum*. In addition a thin layer of *S. cuspidatum* is found in some hollows and there are occasional hummocks of *S. imbricatum* also present. Common Cottongrass and tussocks of Hare's-tail Cottongrass (combined cover of 15-20%) dominate the vegetation in places, while White Beak-sedge dominates in others. This area was burned in the recent past (2008); this is evident from the low growth of Ling Heather (<0.2m), the lack of any *Cladonia portentosa* and the fact that some of the *Sphagnum* hummocks show fire damage. The cover of Bog Asphodel averages at 10% and Carnation sedge at less than 5% but, both of these species reach cover values much higher than this, in places. Tussocks of

Deergrass are also present and these become more frequent as the vegetation grades into a poorer sub-marginal type complex.

This vegetation complex is again found surrounding **C4**, in Clara West, dominating **Sc8**. This area, which is relatively flat, was mapped as 9/10 complex (sub-central ecotope) in the 2004 survey. However, a recent fire (2008) has damaged the vegetation in this location. Nonetheless, ground is still soft to very soft underfoot and the micro-topography consists of low hummocks and hollows. The overall *Sphagnum* cover is high (80%) and mostly consists of *S. capillifolium*, *S. papillosum* hummocks and *S. cuspidatum* hollows. White Beak-sedge cover is high (20-30%) and other accompanying species include Bog Asphodel (20%), Hare's-tail Cottongrass (10-20%), Carnation sedge (1%), Ling Heather, Cross-leaved Heath (both <10cm), Common Cottongrass, Deergrass and Bog Rosemary. *Cladonia* spp. are absent.

Complex 4/10 was found in different locations within **Sc1**; it dominates a large area surrounding **Qsc4** and to the south, the large mineral mound in Clara West (GR: 223798/229888). This area seems to be re-wetting, probably as a result of major subsidence at the edge of the bog, induced by turf cutting along the southern face banks. The complex in this location is characterised by soft ground underfoot despite its high *Sphagnum* cover (70-80%). *Sphagnum* cover mostly consists of *Sphagnum papillosum*, *S. magellanicum* and *S. cuspidatum* lawns with high White Beak-sedge cover. Hollows contain *Sphagnum cuspidatum*, Bog Asphodel and open water. Deergrass is also found. Complex 7/9/10 was also noted in this area.

This complex dominates **Sc2** to the west of Clara West. Micro-topography consists of low *Sphagnum capillifolium*/*S. papillosum* hummocks, and *S. cuspidatum*/White Beak-sedge hollows. *Sphagnum fuscum* hummocks were also reported. Overall *Sphagnum* cover is 60 to 70% and White Beak-sedge (20%), Cross-leaved Heath (20%), Common Cottongrass (10%) and Ling Heather (10%) dominate the vegetation. Bog Asphodel (<5%) and Hare's-tail Cottongrass (1%), Bog Rosemary, *Aulacomnium palustre* and Round-leaved Sundew are also found.

Those areas where *Sphagnum* cover is slightly higher were mapped as **complex 10/4**. This complex was found in several locations on Clara East: Sc 14, 22 and 24. Complex 10/4 along with 9/7/10 dominates **Sc24**.

A wetter version of 4/10 was found within **Sc3** (GR: 223133/230370); here *Sphagnum* dominated pools become frequent and thus the complex was named **4/10+P**. This area is in relatively good condition, with well developed micro-topography and resembles central ecotope. Quadrat **Qsc5** was recorded in this location.

Complex 4/10+P is also found along the northern section of **Sc1** (GR: 223968/230328). The pools here are only partially covered with a relatively thin layer of *Sphagnum cuspidatum*. The *Sphagnum* cover decreases to 40-50% in this location and consists mainly of lawns/low

hummocks of *S. papillosum*. Pools cover approximately 10-20% of the area. Great Sundew was found in these pools as well as Common Cottongrass. Hare's-tail Cottongrass grows on tussocks and reaches a cover value of approximately 10%. Bog Asphodel occurs at a cover value of approximately 5%.

Complex 6/10

This complex was found in six different sections of sub-central ecotope on Clara Bog: **Sc19** on Clara West and **Sc10, 12, 21, 22** and **24** on Clara East.

Sc19 – This section of sub-central ecotope is located to the east of Clara West (GR: 224685/230420) and was reported for the first time in 2009. Peat dams were built adjacent to the track as part of restoration works within this section of the bog. This area is getting wetter and therefore active peat forming vegetation is expanding. **Sc19** is located between two parallel drain (named as D7) completely infilled with *Sphagnum* mosses. This section, although recently damaged by a fire event, features high *Sphagnum* cover (80-90%) consisting of *S. magellanicum* and *S. papillosum* lawns, *S. capillifolium* hummocks as well as very occasionally *S. imbricatum*, and *S. cuspidatum* hollows. *Leucobryum glaucum* hummocks were also recorded. The micro-topography consists of low hummocks, lawns and hollows and very occasionally *Sphagnum cuspidatum*, White Beak-sedge and Common Cottongrass dominated pools. The ground is very soft to quaking underfoot. Bog Asphodel (20% cover) along with Ling Heather and Cross-leaved Heath (20-30% cover and <10cm height) characterise this complex. Additional species include Deergrass (10%), Hare's-tail Cottongrass (5-10%) and Carnation sedge (5%), as well as Common Cottongrass, Bog Rosemary, Great Sundew and Round-leaved Sundew. *Cladonia* spp. are absent. The abundance of Deergrass, Bog Asphodel and Carnation sedge is likely to indicate the transitional nature of this complex, from a drier vegetation type (i.e. sub-marginal) to a wetter one (i.e. sub-central). Quadrat **Qsc7** was recorded within this complex and its location is shown on Map 2 (Appendix IV); the quadrat information recorded is detailed in Appendix III.

Complex 6/10 was also found dominating a large newly mapped sub-central ecotope section to the west of Clara East, named **Sc21**. Restoration work (i.e. blocking of drains and construction of dams) carried out within this section of the bog has resulted in re-wetting of the High Bog and development of new active peat forming vegetation. Surface water running towards the road to the west was noted on the day of the site visit. Ground is soft to very soft and quaking in places. A gentle slope towards the west was noted. The vegetation within **Sc21** is rather variable within sections with lower quality corresponding to sub-marginal ecotope. **Sc21** also features **complex 10/9** in certain places. Micro-topography consists of low hummocks, hollows, *Sphagnum* lawns and pool. Deergrass and Hare's-tail Cottongrass tussocks were also recorded. Pools consist of open water and *Sphagnum cuspidatum*. Robust Ling Heather clumps are present near blocked drains. *Cladonia* spp. cover is very low. Overall *Sphagnum* cover is 60% and mainly consists of *S. papillosum*, *S. magellanicum*,

S. capillifolium and *S. cuspidatum*. A new quadrat was recorded within **Sc1 (QSc10)**. Ling Heather and Cross-leaved Heath (10-20%), Bog Asphodel (5-10%), Hare's-tail Cottongrass (5-10%), Common Cottongrass (5%), White Beak-sedge (5%), Carnation sedge (5%), Deergrass (1%) and Bog Rosemary characterise the complex in this location. Purple Moor-grass and Soft Rush (*Juncus effusus*) were also recorded in some locations within **Sc21**.

Complex 6/10 was again recorded dominated a newly mapped section of sub-central ecotope to the west of Clara East named **Sc22**. This area was not surveyed in 2004 and there is no information to confirm whether this area has developed in the last few years or not. **Sc22** also contains sections dominated by complexes 10/9 and 10/4.

Complex 9/7/10

This complex is the most widespread sub-central ecotope community complex on Clara Bog, it was found within the following sections of sub-central ecotope on Clara Bog: **Sc1, 2, 4-9, 20** on Clara West and **Sc10-16, 21, 23, 24, 28, 29** and **31** on Clara East.

Robust Ling Heather and Cross-leaved Heath (approx. 30cm and 30% cover) and Hare's-tail Cottongrass (20%) characterise this complex. The ground is soft underfoot and micro-topography generally consists of tall *Sphagnum capillifolium* and *S. papillosum* hummocks, hollows containing White Beak-sedge and *Sphagnum cuspidatum* and flats. The overall *Sphagnum* cover is low for a typical sub-central complex (30-40%), however it reaches 60% in places. *Cladonia* spp. are generally present with overall 5% cover. Additional species include Carnation sedge, Bog asphodel and Bog Rosemary. This complex has flush like features in certain locations such as an abundance of Bog Rosemary, Cranberry and *Polytrichum* spp. hummocks.

Complex 9/7/10 was found in a small area to the northeast of **C9** (GR: 223690/230377) within **Sc1**. The ground is very soft underfoot and the micro-topography is well-developed with hummocks, hollows and what appears to be dried out pools. These "pools" support large areas of bare peat and have patchy cover of *Sphagnum*, mainly of *S. magellanicum* and *S. papillosum* although *S. cuspidatum* is also present. Bog Bean was also found as well as Common Cottongrass and White Beak-sedge. Robust Ling Heather (up to 0.5m) dominates (>25% cover) the vegetation occurring mainly on hummocks along with Hare's-tail Cottongrass (10%) and *Cladonia portentosa* (10-20%). The overall *Sphagnum* cover is 50-60% consisting mainly of hummocks of *S. capillifolium* with hummocks of *S. imbricatum* and *S. fuscum* also present. Bog Asphodel is also present (5-10% cover) as well as Bog Rosemary.

Complex 9/7/10 dominates **Sc9**; this area of sub-central ecotope remains very similar to the description given in 2004. Quadrats **Qsc1** was taken within this complex and its location is shown on Map 2 (Appendix IV); the information recorded for the quadrat is detailed in Appendix III. **F16** is found within **Sc9** and consists of a raised mound containing some active

vegetation, mainly *Sphagnum capillifolium* hummocks, Bog Myrtle and Ling Heather. The southern section of **F16** is considered to be active peat forming due to the abundance of *Sphagnum capillifolium* hummocks.

The extent of the sub-central area **Sc5** to the north of Clara West has reduced considerably since the 2004 survey. This area consists of very poor sub-central ecotope with *Sphagnum* cover varying from 50 to 60%, mainly *S. capillifolium*, *S. papillosum* hummocks with frequent Bog Asphodel. Hare's-tail Cottongrass is abundant (20-30%); Ling Heather and Cross-leaved Heath are also frequent (20-30%). Other species present include White Beak-sedge (<5%) and Common Cottongrass (<5%). This section of sub-central ecotope was considered to be transitional between sub-marginal and sub-central in the 2004 survey; the current change in extent may be due to more accurate mapping in the 2009 survey. Other scattered examples of this vegetation type were found within this section of the bog, however these areas were smaller than the minimum mapping unit and were therefore mapped as sub-marginal ecotope. Complex 7/9/10 also dominates **Sc4** where quadrat **Qsc8** was recorded.

This complex was also found to the southeast of **C6** at **Sc20** (GR: 224182/229924). Although sub-central ecotope was reported in this location in 2004, a much larger area of the complex was mapped in 2009. Large *Sphagnum papillosum*/*S. magellanicum* lawns are present. Cross-leaved Heath and Hare's-tail Cottongrass dominate (40% cover). This area also features flush-like characteristics such as frequent Bog Myrtle (5%) and Bog Rosemary.

A small area of 9/7/10 complex was mapped in 2004 to the very south of Clara West (GR: 223541/229719). Complex 9/7/10 has transitional characteristics between sub-marginal and sub-central ecotopes. This area was re-surveyed in 2009 and sub-marginal ecotope 9/7 was found in this location. Therefore, this change is the result of re-allocating this area to a different vegetation ecotope (sub-marginal).

The percentage cover of Hare's-tail Cottongrass, Ling Heather and Cross-leaved Heath vary within complex 9/7/10; the complex is named **7/9/10** in those locations where the percentage of Hare's-tail Cottongrass decreases. In those particular locations where the percentage cover of certain species such as Bog Myrtle, *Cladonia* spp. or the percentage cover of pools increases, the complex has been mapped as **9/7/10+My** (e.g. area between **C7** and **C13** (GR: 223945/229933), **9/7/10+P** and **9/7/10+Cl** (described below).

Complex 7/9/10

This complex was reported to the south of the large marginal ecotope mineral mound on the south of Clara West within **Sc1**. This area seems to be re-wetting as a result of subsidence on the High Bog caused by peat cutting to the south. Quadrat **Qsc9** was recorded in this location.

Sc11 - This section of sub-central ecotope located to the northeast of Clara East is dominated by complex 9/7/10. **Sc11** is currently much smaller than in 2004 and this is the result of re-

allocating sections reported in 2004 as complex 7/9+P (poor sub-central ecotope) to sub-marginal ecotope in 2009.

Sc12 - to the east of Clara East contains a mixture of complexes **9/7/10**, **9/7/10+P**, **10/9** and **10/9a**. The northern section of **Sc12** corresponds to the southern section of the former (2004) sub-central **Sc11**. This section of the bog was not thoroughly surveyed in 2004. The shape of **Sc12** has considerably changed; this is due to more accurate mapping in the 2009 survey.

Sc23 - located to the southeast of **F12**, this area is also dominated by complex 9/7/10. Hare's-tail Cottongrass (40%), tall Ling Heather and Cross-leaved Heath (20%) dominate the complex. This section of sub-central ecotope has flush-like features: *Sphagnum capillifolium* hummocks with Bog Rosemary, Cranberry, *Polytrichum* spp. and Crowberry (*Empetrum nigrum*).

Two patches of sub-central ecotope (complex 10/9) were mapped in 2004 to the east of **F12**, where several drains meet (GR: 225706/229906 and 225789/229824). Currently these two sections are considered to be sub-marginal ecotope (complexes 9/7 and 9/7/3). Although *Sphagnum papillosum*, *S. cuspidatum* hollows are found, the overall *Sphagnum* cover is low. This change is the result of re-allocating this area to a different vegetation ecotope (sub-marginal).

Complex 9/7/10 links flushes **F6**, **F11** and **F12**. Vegetation consists of tall *Sphagnum capillifolium*, Ling Heather hummocks with large hollows dominated by *Sphagnum magellanicum*, *S. papillosum*, and White Beak-sedge. Bog Rosemary is frequent within this complex, which has flush-like characteristics. Hare's-tail Cottongrass and Common Cottongrass are very abundant. Overall *Sphagnum* cover is 60%. Complex 9a+CI was reported adjacent to the east of this sub-central ecotope in 2004. This complex was described as transitional towards sub-central ecotope in the 2004 survey.

Complex 9/7/10 dominates the newly mapped sections **Sc28** and **Sc29**. Neither of these two examples of sub-central ecotope were surveyed in 2004, therefore it is not known whether these vegetation complexes were present or not in 2004.

Complex 9/7/10+P

This complex was found within several sections of sub-central ecotope on Clara Bog: **Sc1**, **2** and **3** on Clara West and **Sc12** and **24** on Clara East.

This complex was reported in 2009 along the western section of Clara West and characterised those sub-central ecotope areas named **Sc2** (GR: 223080/230061) and **Sc3** (GR: 223204/230296). Generally pools have low *Sphagnum* cover in this complex.

Complex 9/7/10+P was also found to the west of **C2** within **Sc1**. Here large inter-connected open water *Sphagnum cuspidatum*/Common Cottongrass pools are found. Robust Ling Heather hummocks are also present. The overall *Sphagnum* cover is rather low (30 to 40%),

consisting mainly of *S. capillifolium*, although *S. magellanicum* is also found. Tall Ling Heather (40%) and Common Cottongrass (10%) dominate the complex. Other species present include White Beak-sedge, Bog Rosemary, Great Sundew and Round-leaved Sundew.

This complex was found in a small area towards the centre of Clara West, to the south of **C9** (GR: 230220/223604) within **Sc1**. The ground is soft to very soft underfoot and the micro-topography is well-developed with hummocks, hollows and pools. The pools cover 10-20% of the surface area, but are mostly open water with only a very patchy and thin cover of *Sphagnum cuspidatum* present. The overall *Sphagnum* cover is 40-50% consisting of *S. cuspidatum* (5%), small lawns of *S. magellanicum* (10-15%), *S. papillosum* (20-25%) and hummocks of *S. capillifolium* (10%). Great Sundew is present in some of the pools. Ling Heather (0.2-0.4m) dominates (25-30%) on hummocks along with Cross-leaved Heath (10%). White Beak-sedge, Hare's-tail Cottongrass, Common Cottongrass and Bog Asphodel are present at low cover values (generally <5%). There is very little cover of *Cladonia* spp. (5%), *Aulacomnium palustre* is also present. Quadrat **Qsc2** (complex 7/9/10+P) was recorded within **Sc6**, which is dominated by complex 9/7/10, to the north of Clara West.

Complex 9/7/10+CI

This complex was found to the northwest of the site of **Sc1** (GR: 223454/230509) and has characteristics of both sub-marginal and sub-central ecotope types. It is evident that this area has not been burned for quite some time as there is very high cover of *Cladonia* spp. (>50% cover in places). The ground is soft to very soft underfoot and the hummock and hollow system is well-developed, but there are no pools. The *Sphagnum* cover is approximately 40%, but is difficult to estimate due to the high cover of *Cladonia* that blankets the vegetation. Most of the *Sphagnum* cover consists of hummocks of *S. capillifolium*, though hummocks of *S. imbricatum* are also present, as well as *S. papillosum* and *S. cuspidatum*, a thin layer of which very occasionally occurs in hollows. The vegetation is dominated by robust (0.4-0.5m) Ling Heather (>40% cover) as well as tufts of Hare's-tail Cottongrass (15-20%). Bog Asphodel was found at low cover values (5%) in hollows.

Complex 10

Sc31- located to the northwest of Clara East, consists of a rather large drain (1.5m wide) and cutaway bog on the High Bog where peat dams were built. Regeneration is taking place and as a result a large *Sphagnum cuspidatum* pool has developed, along with *S. papillosum* and *S. magellanicum* lawns. Cross-leaved Heath, Common Cottongrass and large *Sphagnum papillosum* hummocks surround the pool.

This complex was also found between **F6** and **Sc24** (GR: 225643/230033) and consists of a series of isolated elongated pools. The pools are dominated by *Sphagnum papillosum*, *S. magellanicum* and *S. cuspidatum* but surrounded by sub-marginal ecotope vegetation. Due to

the dominance of sub-marginal vegetation, the pools are only depicted as dots on the vegetation map. The largest pool is 15m long x 3m wide. Other species present include Common Cottongrass, White Beak-sedge, Bog Rosemary, Bog Bean and *Aulacomnium palustre*.

Complex 7/9+Pools (Complex 7/9+P)

This complex was reported along the north eastern section of Clara East. **Sc27** is a rather poor quality sub-central ecotope. Micro-topography consists of large hummocks, pools and flats. This vegetation complex is rather variable, the main characteristic being the occurrence of large irregular pools dominated by *Sphagnum magellanicum*, *S. papillosum*, *S. cuspidatum*, Common Cottongrass, Great Sundew, Bog Bean and White Beak-sedge. Large Bog Asphodel dominated lawns surround these pools, where the *Sphagnum* cover decreases considerably. Although pools are dominated by *Sphagnum* (up to 80%), the overall *Sphagnum* cover within the complex is lower (40-50%). **Sc27** also contains a small section with flush characteristics, mapped as **F15**. A small section of sub-central ecotope (**Sc32**) dominated by 7/9+P is mapped to the east of **Sc27** (GR: 226139/230290). Two small patches of sub-central ecotope are found to the south of **Sc27**; complexes 10/4 and 10/9 characterise **Sc33** and 10/4 characterises **Sc34**.

The western section of **Sc11** is mainly dominated by Complex 7/9+P, which, contains large areas where the *Sphagnum* cover is rather low, for a sub-central ecotope. These areas have now been mapped as sub-marginal ecotope, due to the low *Sphagnum* cover. The reduction in **Sc11** extent is the result of re-allocating some of this area to a different vegetation ecotope (sub-marginal). Patches of complex 7/9+P have been reported in 2009 between **C14** and **Sc11** (GR: 225941/230134). Overall these isolated sub-central patches were too small to map. As they are surrounded by sub-marginal ecotope they were mapped sub-marginal ecotope.

Active Flushes

Flush 1 (F1)

This large flush dominates a sizeable section of Clara West and contains a variety of vegetation types, including wooded areas and two soak system to the southwest. Bog Woodland, named **BW1** in 2004, remains in the northern section of **F1**. A drier Birch woodland (**DBW1**) also described in 2004, located on a ridge, was found in the south eastern section of **F1**. A narrow section of sub-marginal ecotope surrounds DBW1, which is also slightly larger than the area described in 2004. However, there is not sufficient evidence to confirm whether this change is due to an improvement in mapping or an actual change in the extent of the vegetation. Subsidence has been reported near the large mineral mound to the east of **F1** (approx. 100m), which may indicate that this section of **F1** may be subject to

further subsidence. Overall, **F1** remains very similar to the description given in 2004 and only slight changes in the boundary were noted.

Flush 2 – Shanley's Lough Flush (F2)

This is a diverse and largely active flush that is found mostly to the south and west of Shanley's Lough. **F2** remains very similar to the description given in 2004. Two small Birch dominated dry woodlands (**DBW2** & **DBW3**) in the south of this flush remain inactive. Two open water ponds described and mapped in 2004 were also reported in the 2009 survey. No major changes were noted in the two areas of Bog Woodland habitat (**BW2** and **BW3**) found within **F2**.

Flush 3 (F3)

This linear flush was found to the east of Shanley's Lough and has developed around and into an old blocked drain. The southern part of the flush remains inactive. However, an area to the southwest of **F3** (GR: 224004/229868) seems to be getting wetter, which was evident from the expansion of sub-central ecotope. Two Bog Woodland examples (**BW4** & **BW5**) described in 2004 still contain active peat forming vegetation. A much larger northern section of **F3** was mapped in the 2009 survey. This area of active peat forming vegetation consists mostly of *Sphagnum capillifolium*, *S. magellanicum* hummocks (80%), small Birch samplings (0.75-1m), Ling Heather (40%) and Cranberry. Quadrat **Qf1** was recorded within this section.

Flush 4 (F4)

This flush located to the southwest of Clara West adjacent to **C12** was mapped as two separate areas (**F4a** and **F4b**) in 2004. A small section of **F4a** was found to be active in 2009 and it is characterised by the abundance of tall *Sphagnum capillifolium* hummocks.

Flush 5 (F5)

This flush is located to the south of **Sc1**. **F5** is a narrow strip dominated by Purple Moor-grass with patches of Bog Myrtle and several groups of Downy Birch saplings and trees (4 m high). Soft Rush is present in this area and there are a number of swallow holes. Although **F5** mostly consists of inactive vegetation the southern section of this flush is very wet and contains high cover of *Sphagnum capillifolium*. This section is considered to be active peat forming.

Flush 6 - Lough Roe (F6)

Lough Roe, which is an active soak, is found close to the centre of Clara East. It remains very wet and it features very similar vegetation to that described in 2004. The 2009 survey found that **F6** was much larger than that surveyed in 2004. In fact, **F6** seems to be connected to **Sc10** to the north and **Sc15** to the south through a band of sub-central ecotope and **F12**, which features a small section of active peat forming vegetation, to its west. It is uncertain whether this change in the extent of **F6**, is due to changes in the vegetation since 2004, or is a result of a more detailed survey in 2009. Nonetheless, the western section of Clara East where **F6** is located seems to be undergoing re-wetting processes as the expansion of sub-central areas such as **Sc10** and newly mapped **Sc21** and **Sc22** indicate. It has already been noted that Lough Roe has changed considerably in recent years with bog communities replacing the original poor fen type communities (Crushell pers. comm.).

Flush 7

This active flush, which contains scattered Birch trees, is located to the west of Lough Roe. Similar species to the ones reported in 2004 were found in 2009. The extent of this flush was found to be slightly larger in 2009 to that mapped in 2004. The surrounding High Bog vegetation now contains sub-central ecotope (**Sc21**) and this section of the bog is getting wetter.

Flush 8

This active peat forming flush found in the mid-southwest of Clara East remains very similar to the description given in 2004. High *Sphagnum* cover (70-80%) characterise the flush, mostly consisting of *S. magellanicum* and *S. papillosum* lawns and hummocks. *Sphagnum cuspidatum* hollows are also present. Hare's-tail Cottongrass (10%), Ling Heather and Cross-leaved Heath (20%), White Beak-sedge and Bog Asphodel (<5%) dominate the vegetation. *Aulacomnium palustre*, *Dicranum bonjeanii* and Bog Bean are found growing through the *Sphagnum*. *Sphagnum cuspidatum* pools, which were recorded in the 2004 survey, are now absent. This indicates that the flush has become slightly drier since the last survey.

Flush 9

This flush/soak located in the south eastern part of Clara East remains active. Ling Heather and large *S. capillifolium* and *S. papillosum* hummocks characterise **F9**. Crowberry and *Cladonia* spp. are also found. This flush was found to be much larger than in 2004. Some sections of **F9** that are currently mapped as active were considered to be sub-marginal ecotope (9/7 and 7/9) in 2004. This indicates that this area of the bog is getting wetter and the active peat forming vegetation is expanding. The 2009 survey also found that **F9** is connected

to an area of sub-central ecotope to its north and to **Sc13** to the south. This area of the bog contains several blocked drains that were blocked and where in-filling has taken place.

Flush 11

This flush located in Clara East was considered to be inactive in 2004. However, it is now very wet and contains high *Sphagnum* cover and is therefore considered to be active peat forming. Furthermore, it is part of a large active peat forming system connecting **Sc10** to **Sc15** through **F6** and **F12**. Ling Heather and Purple Moor-grass are present.

Flush 12

This flush is located 100m SE of Lough Roe and it is dominated intermittently by Purple Moor-grass, robust Ling Heather with scattered Birch (1-4m high) and Eared Willow (*Salix aurita*). The Western section is very wet and contains high cover of *Sphagnum capillifolium*, and is now considered to be active. Species reported in 2004 are still present. This flush is connected to **F11** to the north through a newly mapped section of sub-central ecotope.

Flushes 13 (a - j)

Flushes 13 (a - j) were previously described as in-filling pools (soaks). These correspond to a series of large *Sphagnum* dominated pools found to the northeast of Clara East, which were considered active soaks in 2004. Some of these pools are visible on the 1910 six inch map. Generally, there is excellent cover of *Sphagnum* (>70%) within these pools, composed mainly of *S. cuspidatum*, but *S. magellanicum* and *S. papillosum* are also present. Common Cottongrass is usually the dominant higher plant. **F13a** is surrounded by typical active flush vegetation (**F17**). **F13a** consists of a large *Sphagnum cuspidatum* dominated pool with Bog Bean and Hare's-tail Cottongrass. *Sphagnum magellanicum*/*S. papillosum* lawns are also present. Bog rosemary, Bog Asphodel, Crowberry and Round-leaved Sundew surround the pool. Ling Heather and tall *Sphagnum capillifolium* hummocks with Crowberry and *Cladonia* spp. characterise the active flush surrounding **F13a**. **F13j** which contained open water in the 2004 survey has been in-filled with *Sphagnum* spp. **Qf2** was recorded within **F13c**.

Flush 14

This soak, found to the south of Clara West, which, was mapped as **C13** in 2004, consists of very large *Sphagnum cuspidatum* open water pool with abundant Hare's-tail Cottongrass and Common Cottongrass. Tall *Sphagnum papillosum* hummocks and *S. magellanicum* lawns are also found at the edge of the large pool. Other species found in this area include Cross-leaved Heath, Ling Heather and Bog Asphodel.

5.2.2. Degraded Raised Bog

Sub-Marginal Ecotope Complexes

Complex 4/9

This rather wet example of sub-marginal ecotope vegetation complex was found along the south eastern section of Clara West. The northern examples of this community complex type to the north of **Sc8** were affected by the 2008 fire event and *Cladonia* spp. are absent.

This complex is characterised by soft ground and micro-topography consisting of low hummocks and hollows and the absence of pools. White Beak-sedge reaches 40% cover in places, Ling Heather and Cross-leaved Heath cover ranges from 10 to 20% and both are found in low growth form (<10cm) in those areas that have been recently burned. Bog Asphodel is also present within 4/9 and its cover is less than 10%. Other species found within 4/9 include Deergrass (<5% cover) forming tussocks, Common Cottongrass and Hare's-tail Cottongrass (10%), Carnation sedge (<10%) and Round-leaved Sundew. The overall *Sphagnum* cover ranges from 30 to 40% and mainly consists of *S. capillifolium* and *S. papillosum*. *S. imbricatum* and *S. cuspidatum* are also found within hummocks and hollows respectively.

This complex was recorded to the south of **F5**; here the ground is firm underfoot. Abundant White Beak-sedge (20%) and Common Cottongrass (10%) characterise this complex. Low Ling Heather and Cross-leaved Heath (<20cm) are also commonly found (30%). Bog Asphodel (<5%) and Bog Rosemary were also recorded. *Sphagnum*, mainly *S. capillifolium* and *S. papillosum* hummocks, cover 30% of the ground. *Cladonia* spp. cover is less than 5%.

This vegetation complex becomes **4/9/6** in some locations within Clara West where the percentage cover of Bog Asphodel increases (e.g. GR: 224383/229965).

A variant of this complex with pools containing Bog Bean was found between **C3** and **C4** (GR: 2244278/230327), here the complex is named **4/9+P**.

Complex 4/7

This complex was found to the west of **C3**. The ground is soft to very soft underfoot and the *Sphagnum* cover is 30-40%. The micro-topography consists of low hummocks and hollows. White Beak-sedge and Ling Heather characterise the vegetation with White Beak-sedge (30%) dominating the hollows and Ling Heather (25-30%) dominating the hummocks (along with Cross-leaved Heath). Hummocks mostly consist of *Sphagnum capillifolium* but *S. imbricatum* was also recorded. Hollows are often devoid of any *Sphagnum* cover, though there is patchy cover of *S. cuspidatum*, *S. papillosum* and *S. tenellum*. Most other species have a very low cover value except Bog Asphodel, which reaches cover values of 10-20%,

becoming frequent in the hollows in places. Hare's-tail Cottongrass also reaches cover values of approximately 10% in places, usually where there is higher *Sphagnum* cover.

Complex 9/7

This complex covers large areas across both sections of Clara. It has some characteristics of sub-central ecotope and grades into complex 9/7/10 (sub-central ecotope) in places. Therefore, it usually occurs as a transitional complex between 9/7/10 and the poorer sub-marginal complex 9/7/6. Ground under complex 9/7 is soft underfoot. Hummocks and hollows dominate the micro-topography and pools are absent. The *Sphagnum* cover is approximately 30-40% consisting mostly of hummocks of *S. capillifolium* with *S. papillosum*, with *S. magellanicum* occurring in places (usually where there is an improved *Sphagnum* cover grading into complex 9/7/10). There are also occasional hummocks of *S. imbricatum* and a thin patchy layer of *S. cuspidatum* in some hollows. Ling Heather (25-30%) and Hare's-tail Cottongrass (10-20% increasing where the vegetation grades into complex 9/7/10) dominate the vegetation. Cross-leaved Heath (5-10%), Common Cottongrass (5%) and Bog Asphodel (5%), also occur and cover increases in these species where complex 9/7 grades into complex 9/7/6. Carnation sedge and White Beak-sedge are present in patches.

This complex was found along the southern section of Clara West (GR: 223553/229749). Ling Heather and Cross-leaved Heath dominated in this location (30-40%). Hare's-tail Cottongrass (10%), Common Cottongrass (5%), Bog Asphodel (<5%) and White Beak-sedge (<5%) are also present. Micro-topography consists of low *Sphagnum capillifolium*, *S. papillosum* hummocks and White Beak-sedge, and *Sphagnum cuspidatum* hollows and flats. The overall *Sphagnum* cover is 20%. *Cladonia* spp. cover is relatively high in this location (5-10%).

A drier version of this complex was found in a newly mapped, elongated, sub-marginal ecotope section, located to the south of Clara West, between **C11** and **C12** (GR: 223465/229879). Here, Purple Moor-grass becomes frequent and the complex is named **9/7+Molinia**. The vegetation is located on a slightly raised surface running SW-NE, likely to correspond to a mineral ridge, although further work is required to confirm this. This area was mapped as sub-central ecotope in 2004.

Complex 9/7 was also reported between **Sc16** and **Sc22**. Hare's-tail Cottongrass cover reaches 30%, Ling Heather, up to 30cm tall, (20-30%) and Cross-leaved Heath (10%). Micro-topography consists of low hummocks, hollows and Hare's-tail Cottongrass tussocks. Overall *Sphagnum* cover varies from 20 to 30% and mostly consists of *S. capillifolium* hummocks. *Cladonia* spp. cover is rather high in this location (20-30%). This complex grades into 9/7/3 where the cover of Carnation sedge increases.

Complex 9/7+P

This complex was recorded along the southern section of Clara East (GR: 225447/229323). Irregular shape pools filled with *Sphagnum papillosum*, White Beak-sedge, Bog Bean and Great Sundew are found within this complex. Pools occasionally are bare of *Sphagnum* and only contain open water. Surrounding ground is poor in *Sphagnum* spp.

Complex 9/6

This vegetation complex is mainly found along the north-eastern section of Clara West, surrounding **Sc8** and the newly mapped **Sc19**. This area was damaged by the 2008 fire event. *Sphagnum* cover decreases to 40-50% in comparison to adjacent sub-central ecotope (4/10 complex) and bare peat cover is 5% in places. Bog Asphodel (30%), White Beak-sedge (20%), Common Cottongrass (10%), Deergrass (5%) and low Ling Heather and Cross-leaved Heath (<10cm) characterise this complex. Micro-topography consists of low hummocks of *Sphagnum capillifolium* and *S. papillosum*, although *S. imbricatum* was also found and *S. cuspidatum* hollows.

Complex 9/7/3

This vegetation complex was found dominating large tracts of Clara East, although it is also found in Clara West.

Complex 9/7/3 along the eastern section of Clara West shows evidence of a fire event which occurred in 2008 (e.g. *Cladonia* spp. absent, low heather species growth (<15cm), damaged *Sphagnum* spp.). This complex is characterised by a micro-topography consisting of low hummocks and hollows. Pools are only very occasionally found. The overall *Sphagnum* cover is 20%. Ling Heather, Cross-leaved Heath (25% cover), Hare's-tail Cottongrass (20%), and Carnation sedge with a percentage cover varying from 10 to 20% in places, dominate the vegetation. Other species found include Bog Asphodel (<5% cover), Bog Rosemary, Common Cottongrass, Deergrass, Round-leaved Sundew, *Dicranum scoparium* and Cranberry. *Sphagnum capillifolium* and *S. papillosum* dominate the *Sphagnum* layer. *S. fuscum* was also recorded. *Cladonia* spp. cover reaches 5% in those areas not affected by the recent fire on Clara West. The vegetation here is characterised by a higher *Ericaceous* shrubs cover (up to 30%) with higher growth (30 cm) and higher *Sphagnum* spp. cover (30%) mostly consisting of *S. capillifolium* and *S. papillosum*.

Complex 9/7/6

Complex 9/7/6 was found dominating large tracts of both Clara West and East. This vegetation complex is rather similar to complex 9/7 but with a higher cover of Bog Asphodel.

This complex was found covering large areas to the north and northwest of Clara West (GR: 223930/230395). The surface is soft underfoot and the micro-topography is moderate to well-developed with hummocks and hollows, but no pools. The *Sphagnum* cover is 25-30% and consists mainly of hummocks of *S. capillifolium* although *S. papillosum*, *S. subnitens* and *S. cuspidatum* also occur. Ling Heather (0.3-0.5m) and Cross-leaved Heath dominate the hummocks occurring at a combined cover of 30-40%, while Bog Asphodel (10-20%) dominates the hollows. Tussocks of Hare's-tail Cottongrass (5-10%) are found on hummocks while White Beak-sedge (5-10%) is found in hollows. Where the cover of *Cladonia* spp. increases (more than 20%) the complex is mapped as **9/7/6+CI** (GR: 223690/230655).

Complex 9/7/6 dominates a mound to the northeast of **C11** (GR: 223561/229875). Cross-leaved Heath (30%), Hare's-tail Cottongrass (20%) and Bog Asphodel (5%) dominate the vegetation in this location. *Cladonia* spp. are abundant (30%) and micro-topography consists of low hummocks of *S. capillifolium*, *S. papillosum* and *S. cuspidatum*. White Beak-sedge hollows are also found.

This complex was also found in the south of Clara West on a steep gradient sloping to the east down from the mineral mound to an area of central complex 14 (**C5**). The surface is firm to soft underfoot. *Sphagnum* cover is approximately 30%, consisting mostly of hummocks of *S. capillifolium*, although *S. papillosum* and *S. tenellum* are also present. Ling Heather (0.3m) and Cross-leaved Heath dominate the vegetation with a combined cover of >50% while Bog Asphodel (10-20%) dominates the hollows. Tussocks of Deergrass (5-10%) are also prominent and the cover of Hare's-tail Cottongrass (5%) and Common Cottongrass is low (<5%). There are small patches of bare peat and the cover of *Cladonia* spp. is low (<5%). The complex grades into the marginal complex 7/2 towards the mineral mound.

A variant of this complex (named **Complex 7/6/2**, as it has a higher cover of Deergrass) was found to the northeast of Clara West, where there is a slope down towards the bog margin in the north. The *Sphagnum* cover is 20-25% and consists mainly of hummocks of *S. capillifolium* although thin patches of *S. cuspidatum* are found in some hollows. The cover of Ling Heather (0.3-0.5m) and Cross-leaved Heath is lower here (combined cover of 30%) and is largely restricted to the hummocks. Bog Asphodel (10-20%) again dominates the hollows and tussocks of Deergrass are more prominent (10-20%). The cover of *Cladonia* spp. is low (5-10%).

Complex 6/9/2

This complex was found in the east of Clara West, where sub-central complex 6/10 (**Sc19**) grades into complex 6/9/2. The sub-central area occurs mainly between and around the old blocked drains. However, towards the SSW, there is a slope upwards and the area becomes drier and grades into this sub-marginal complex. Here the ground is firm to soft underfoot and the *Sphagnum* cover is patchy and averages at 40%. *Sphagnum capillifolium* (20-30%) and *S. papillosum* (10-20%) dominate the moss layer though *S. magellanicum* and *S. cuspidatum* also occur. The micro-topography is poorly developed and consists of very low hummocks, shallow hollows and very few pools. The vegetation shows evidence of recent burning, with patches of bare peat, low growth of Ling Heather (<0.2m) and little or no cover of *Cladonia* spp.; the *Sphagnum* hummocks are showing signs of recovery. Bog Asphodel dominates the vegetation (20-30%) and tussocks of Deergrass are very prominent (10-15% cover). Hare's-tail Cottongrass (10%) and Common Cottongrass occur throughout the vegetation and dominate in places. Ling Heather, although low growing, occurs at approximately 20% cover and White Beak-sedge and Cross-leaved Heath are also present. Carnation sedge is found here at a low cover value (<5%), but becomes more frequent in patches grading into 6/9/3 (marginal ecotope).

Complex 4/3/6

This complex was found to the northeast of Clara West (GR: 224428/230709). The surface is soft underfoot and the micro-topography is poorly developed, being dominated mostly by flats with occasional low hummocks and hollows. The *Sphagnum* cover is approximately 20-30%, but is patchy. Indications of burning in the recent past are evident from the low growth of Ling Heather (<0.2m), the extensive patches of bare peat and the lack of any cover of *Cladonia* spp. White Beak-sedge dominates large areas of this complex as does Bog Asphodel, while Carnation sedge dominates in smaller, more localised patches. Hare's-tail Cottongrass (<5%), Common Cottongrass (<5%), Cross-leaved Heath (5%) and Ling Heather (5-10%) occur at low cover values. Where the percentage cover of Bog Asphodel increases the complex is named **4/6/3**.

Marginal Ecotope Complexes

Complex 6/9/3

This marginal complex was found covering some sections along the eastern boundary of Clara West (e.g. south of **C4** and north east of **Sc19**). The ground is firm to soft in places and the area is mainly flat. Micro-topography consists of low hummocks, flats and scattered shallow hollows. Pools are absent. The overall *Sphagnum* cover is less than 10% consisting mostly of *S. capillifolium* hummocks and *S. papillosum* and *S. cuspidatum* hollows. Bog Asphodel (20-30%), Hare's-tail Cottongrass (20%) and Carnation sedge (10%) characterise this complex. Ling Heather and Cross-leaved Heath are also abundant (30% cover) and less than 30cm in height. *Cladonia* spp. cover is less than 1%.

Complex 7/2

This complex was found dominating several mounds scattered over Clara West (GR: 224000/230697, 223872/230070 and 223592/229780). The complex is characterised by firm ground underfoot and low *Sphagnum* cover (up to 20% in places). Ling Heather and Cross-leaved Heath dominated (30% cover) along with Deergrass tussocks (5%) and Bog Asphodel (5%). Although low *S. capillifolium*, *S. papillosum* hummocks and hollows may be present, micro-topography is rather flat.

This complex was also found on a medium size mound located between **C5** and **C8** the south of Clara West (GR: 223977/230197). The surface is firm underfoot and the micro-topography is poorly developed. The *Sphagnum* cover is low (approx.10%), consisting mainly of hummocks of *S. capillifolium*. Ling Heather (0.3-0.5m), dominates the vegetation covering more than 50% of the mound. Tussocks of Deergrass are also prominent (10% cover), especially where there is a slope. Other species present include Bog Asphodel (10%), Hare's-tail Cottongrass (5-10%), Cross-leaved Heath (10%) and *Cladonia* spp. (5-10%). Bare peat patches are also present. In flat areas at the top of the mound, this complex becomes Complex 7. Here Ling Heather increases to more than 75% cover and 0.5m in height and Deergrass is absent.

Complex 3/6/2

This complex was found along the eastern section of Clara West and north-western section of Clara East.

To the east of Clara West (GR: 224901/230410) a relatively steep slope down to the road that dissects Clara West from Clara East was noted. The area appears to have been recently burned, indicated by the lack of *Cladonia* spp. and the presence of bare peat (up to 50% cover in places). The micro-topography here is very poorly developed and the area is dominated by flats although there are occasional algal hollows and hummocks of *Leucobryum*

glaucum. The ground is firm underfoot and the *Sphagnum* cover is poor (<10%), consisting mainly of *S. capillifolium*. Carnation sedge dominates (up to 50%) the vegetation. Bog Asphodel is also abundant (20%) cover and tussocks of Deergrass are frequent (10%). Ling Heather and Cross-leaved Heath are very low growing (<0.1m) and occur at approximately 10% cover. Hare's-tail Cottongrass, White Beak-sedge and Round-leaved Sundew are also present. To the south of the track that leads into Clara West from the road, there are areas (230310 224840) where the *Sphagnum* cover increases, the ground becomes slightly softer, there is less Carnation sedge and a higher cover of Common Cottongrass and Bog Asphodel (up to 50% in places).

Complex 3/4/2

This complex was found to the west of Clara East (GR: 225032/230412) where a gentle westward slope was noted. Ground is firm underfoot and bare peat (up to 10%) is present. Micro-topography consists of low hummocks (mainly *Sphagnum papillosum* and *S. capillifolium*), flats and hollows. Overall *Sphagnum* cover is low (<10%). Carnation sedge (30%), Ling Heather, Cross-leaved Heath (20%), White Beak-sedge (<5%) and Deergrass tussocks (1%) characterise the vegetation.

Complex 6/3

Complex 6/3 was found in the east of Clara West, south of Complex 3/6/2, where there is a slight eastward slope down to the road. This area has not been burned as recently as Complex 3/6/2 (GR: 224655/230083). The micro-topography is poorly developed and the *Sphagnum* cover is approximately 10%. The ground is firm to slightly soft underfoot and there are occasional patches of bare peat (5%) and very little cover of *Cladonia* spp. (<5%). Bog Asphodel dominates the vegetation (>50% cover in places). Carnation sedge is also prominent (10-15%) and Ling Heather and Cross-leaved Heath grow up to 0.25m in height and occur at a combined cover of approximately 25% cover. Tussocks of Deergrass occur at approximately 5% cover and White Beak-sedge occurs in places at 5-10% cover.

Complex 6/7

This complex was found in several locations around the edge of Clara East High Bog. The ground is firm and a gentle slope towards the edge of the High Bog characterise this complex. Micro-topography is poorly developed and consists of flats and very occasional low hummocks (mostly *Sphagnum capillifolium* and *S. papillosum*). Bog Asphodel (up to 60%), Ling Heather, Cross-leaved Heath (20-30%) and Carnation sedge (10%) dominate this complex. *Cladonia* spp. cover is relatively high (10%) in places.

Complex 6/7 also dominates the large mound found to the southwest of Clara East (GR: 225284/229522). Ground is firm underfoot with low *Sphagnum* cover (<5%) consisting mainly of *S. capillifolium* hummocks. Robust Ling Heather (30-40cm and 40% cover), Bog Asphodel (10%) and Carnation sedge (5-10%) dominate the complex. *Cladonia* spp. cover is 5%.

Facebank Complexes

Complex 1

This complex surrounds much of the High Bog perimeter at Clara Bog. Ling Heather dominates the vegetation (up to 100% cover) and the ground is dry and hard underfoot indicating a low water table. Cross-leaved Heath, Common Cottongrass, Deergrass, Carnation Sedge and Bog Rosemary are all present at low cover values and there is little or no *Sphagnum* cover. The ground layer is dominated by *Hypnum jutlandicum*, which is usually abundant under Ling Heather. *Cladonia* spp. are abundant in areas that have not been burned in the recent past.

Inactive Flushes

Flush 10

Ling Heather dominates this flush with a patch of scattered Purple Moor-grass tussocks and scattered Downy Birch trees. This flush was described as inactive in 2004 and remains so.

There are a number of other small inactive flushes on Clara East that are shown in Map 1 (Appendix IV). These flushes were not described in detail during the 2009 survey.

6. IMPACTS AND ACTIVITIES

6.1. Peat cutting

Presently, peat cutting continues along the southern margins of both Clara West and Clara East. This cutting is associated with massive subsidence and slumping of the High Bog along parts of this High Bog margin.

Since the bog was surveyed by Kelly in 1993, two small lakes have developed close to the mineral mound on Clara West. This is due to subsidence of the peat body caused by drainage and turf cutting (Fernandez *et al.*, 2005). Over half (55.68%) of the original bog area has been cutaway since the 1800s, with the most intense cutting having occurred to the south of the present day High Bog. Currently peat cutting consists of hopper-cut and is mostly for domestic use. One plot on Clara Bog was approaching a commercial nature in 2003 (Fernandez *et al.*, 2006).

The immediate and rapid cessation of turf cutting in 26 out of 60 plots that were considered to be active in 2003 was recommended by Fernandez *et al.* (2006). Peat cutting at these plots was deemed to be having a very serious threat to the Active Bog. In addition, the cessation of peat cutting in the remaining active plots was recommended within a period of five to ten years since the survey took place in 2003. However, cessation of turf cutting has only taken place at three plots (i.e. 2, 3 and 4) at Clara Bog according to Malone (2009). This activity continues to seriously threaten those habitats present on the High Bog including Annex I priority Active Raised Bog habitat.

6.2. Drainage

6.2.1. High Bog Drainage

The majority of drains in the High Bog have been blocked by NPWS (Fernandez *et al.*, 2006). A number of short drains, associated with turf cutting plots, in the southwest of Clara West were described as functional in 2003. These drains however, were not considered to have a significant drying out effect on the High Bog. A short drain (D1) in the southwest of Clara West was also described as functional and was considered to be having a negative impact on the bog.

An intensive drainage scheme excavated by Bord Na Móna took place in Clara East in 1983. Drains were dug at 20 metre intervals in a NNE-SSW direction with some east-west drains also excavated at various intervals (Kelly, 1993). Some of these drains were blocked to varying degrees of success in 1987 (Kelly, 1993). A management plan for the efficient blocking of the drains was prepared by Streefkerk and Douglas (1994), and most were blocked effectively in 1995/96 (van der Schaaf, 2002).

The most serious drainage problem affecting Clara Bog is that caused by the road which runs through the centre of the bog and the deep drains which have been excavated on either side of it. This road has resulted in massive subsidence of the bog (van der Schaaf, 2002) since it was constructed over 150 years ago (Kelly, 1993).

6.2.2. Bog Margin Drainage

The cutover areas were not surveyed for drains during 2009. However, van der Schaaf (2002) noted that there were deep drains excavated in the cutaway in the south of Shanley's Lough with drain levels of about 6m below the bog surface. These drains are causing considerable subsidence in the bog area between Shanley's Lough and the southern margin with measurable effects recorded more than 300m from the bog margin in 1997 (Schouten, 2002). Furthermore, Kelly (1993) noted that a drain running along the northern boundary of Clara East was deepened and widened in 1991 as part of a reclamation scheme for agricultural land adjoining the bog. This caused considerable damage to some marginal vegetation communities in the area.

Arterial drainage schemes were carried out in the region in the 1850s and again in the 1950s, resulting in the lowering of the regional water table (O'Mahony, Draft). Drains are also found around the margins of the bog, where they have been dug to drain agricultural land or peat cutting banks. The main road and the drains running parallel to that road have also had a major effect on the hydrology of the bog and have split the original dome into two smaller domes (Schouten, 2002). Water flows towards the road from both Clara East and West, the road also acts as the major drain for lands on the northern margin of the bog. In the central part of present day Clara West, the subsidence caused by the drainage system that was installed in connection with the Clara-Rahan Road since the time that the road was built, has been approximately 2m (van der Schaaf, 2002). The subsidence in the area of Shanley's Lough has been 4-5m and the effect of peat cutting in the south of the site has augmented the subsidence caused by the road. The average subsidence of Clara West between 1982 and 1991 was 2cm/yr. Subsidence on Clara Bog has changed the topography of the bog surface from the original flat/domed shape, to a more undulating shape. The undulations correspond to the topography of features underneath the bog (van der Schaaf, 2002).

6.3. Fire History

A fire event took place in 2008 and seriously affected the north eastern section of Clara West. This fire completely burned **Sc18** and partially burned **Sc8** and **Sc19**.

7. ASSESSMENT OF CHANGES IN THE 2004 TO 2009 PERIOD

The assessment of changes in High Bog vegetation is based on the comparison of ecotope extent calculated for both the 2004 and 2009 surveys. Similar methodologies were employed for both of these surveys (see section 3). Community complex descriptions were also taken into account to justify changes in ecotope. Changes in quadrats indicators (e.g. indicator species) were also analysed for the 2004-2009 period.

Ideally, the monitoring of changes in surface levels and hydrological variables should be incorporated into the analysis. This would help further the understanding of potential changes in the High Bog vegetation. Unfortunately, this type of monitoring was not part of the scope of this study.

7.1. Changes in ecotope extent

A comparison of ecotope extent for the 2004 and 2009 surveys is given below.

Table 7.1 Variation in Active Raised Bog area in Clara West

Active Ecotopes	2004	2009	Variation in Active Ecotopes	
	Area (ha)	Area (ha)	Area (ha) (+/-)	%(+/-)
Central	9.38	10.72	(+)1.34	(+)14.29
Sub-central	43.35	51.28	(+)7.93	(+)18.29
Active flush	16.48	16.51	(+)0.03	(+)0.18
Bog Woodland	1.38	1.38	(+)0.00	0.00
Total	70.59	79.89	(+)9.3	(+)13.17

Table 7.1 indicates there has been a slight increase in the extent of central ecotope in Clara West, this is mainly the result of an increase in the extent of central ecotope at **C5** (see table 7.5).

The extent of sub-central ecotope has increased by 7.93ha. Approximately 5ha of this increase corresponds to sub-central ecotope areas (southern section of **Sc1**, **17**, **18**, **19** and **20**) where this ecotope is likely to have recently developed, as a result of drain blocking. This could also be due to re-wetting caused by subsidence induced by drainage along the southern section of Clara West (see table 7.5).

The central ecotope area (**C13**) was considered to be an active peat forming soak in 2009 and therefore was named **F14** (see Map1; Appendix IV).

Table 7.2 Variation in Active Raised Bog area in Clara East

Active Ecotopes	2004	2009	Variation in Active Ecotopes	
	Area (ha)	Area (ha)	Area (ha) (+/-)	%(+/-)
Central	0.57	0.58	(+)0.01	(+)1.75
Sub-central	25.28	25.51	(+)0.23	(+)0.91
Active flush	3.89	5.50	(+)1.61	(+)41.39
Total	29.74	31.6	(+)1.86	(+)6.25

Although figures in table 7.2 do not show major changes in the extent of sub-central ecotope at Clara East, this section of Clara has seen the highest increase in the extent of this ecotope. Expansion and/or new generation of sub-central ecotope induce by drain blocking seem to have taken place in the following sections (**Sc10, 13, 21-26, 28, 29** and **31**). Map 1 illustrates significant changes in the extent of sub-central ecotope along the northeast section of Clara East. These changes are the result of more accurate mapping in the 2009 survey and re-allocating some areas previously mapped as sub-central ecotope (e.g. 7/9+P described as transitional sub-central sub-marginal) to sub-marginal ecotope.

Expansion of central ecotope seems to have taken place in **C17** and **20**.

The significant increase in the extent of active flush is likely to be a result of drain blocking (**F6** and **9**); more accurate mapping in the 2009 survey may also be a contributor to this change in extent.

Table 7.3 Variation in Degraded Raised Bog area in Clara West

Inactive Ecotopes	2004	2009	Variation in In-active Ecotopes	
	Area (ha)	Area (ha)	Area (ha) (+/-)	%(+/-)
Sub-marginal	111.48	106.55	(-)4.93	(-)4.42
Marginal	56.50	51.69	(-)4.81	(-)8.51
Face-bank	6.11	6.22	(-)0.11	(-)1.80
Inactive flush	1.71	2.07	(+)0.36	(+)21.05
Dry Bog Woodland	0.21	0.29	(+)0.08	(+)38.09
Open water	0.19	0.19	0.00	0.00
Total	176.20	167.01	(-)9.19	(-)5.22

Figures in table 7.3 do not show major changes in the extent of Degraded Raised Bog vegetation at Clara West.

Table 7.4 Variation in Degraded Raised Bog area on Clara East

Inactive Ecotopes	2004	2009	Variation in In-active Ecotopes	
	Area (ha)	Area (ha)	Area (ha) (+/-)	%(+/-)
Sub-marginal	95.02	98.24	(+)3.22	(+)3.39
Marginal	62.41	61.47	(-)0.94	(-)1.51
Face-bank	8.03	4.49	(-)3.54	(-)44.08
Inactive flush	1.13	0.59	(-)0.54	(-)47.79
Open water	0.09	0.07	(-)0.02	(-)22.22
Total	166.68	164.86	(-)1.82	(-)1.09

Figures in table 7.4 do not show major changes on the extent of Degraded Raised Bog vegetation at Clara East.

7.2. Changes in individual active peat forming areas

The following is a summary of changes that, according to the information collected as part of the 2004 and 2009 surveys, have taken place in the Clara Bog vegetation in active peat forming areas. A more detailed description of changes for each individual area of active peat forming vegetation is given in table 7.5 below.

Expansion and/or new generation of active peat forming vegetation

- Changes seem to have taken place along the southern boundary of Clara West with central ecotope section **C5** recorded as being slightly larger; Sub-central ecotope is also expanding to the south in several locations of **Sc1**: Expansion south of a large mound where quadrat Qsc9 was recorded and to the southwest of **F2**; Sub-central ecotope was also noted to be expanding within **Sc20** and a small section of **F5** currently considered to be active peat forming.
- Evidence of re-wetting and expansion of active peat forming vegetation was noticed in the following areas:
 - Clara East: **C17** southern section; **C20**, **Sc13**, **23**, **24** and **26** middle section and **Sc10**; **Sc21**, **22**, **25**, **F6** and **11** western section; **Sc28** and **29** northeast section and **Sc31** northwest section.
 - Clara West: **Sc17** southeast; **Sc18** northeast and **Sc19** east.

Decrease in active peat forming vegetation or drying out processes

- A decrease in the extent of active peat forming vegetation in the northwest section of Clara West was reported in the 2004 survey (Fernandez *et al.*, 2005). This decrease is likely to have continued in the 2004-2009 period as the reduction in the extent of **Sc5** and **Sc7** indicates.
- Drying out processes and further subsidence along the southern section of Clara West. The south-eastern section of **F1** (GR: 223617 / 230014), west of a large mound, has seen sub-marginal ecotope and inactive flush expand. This area was mapped as sub-central ecotope by Kelly (1993). This is likely to indicate further subsidence along the southern section of Clara West. This is in conjunction with that taking place in the area surrounding the large mineral mound, located to the south of Clara West.
- Further subsidence is likely to be taking place between **C11** and **C12** to the south of Clara West (GR: 223465/229879). Sub-marginal complex 9/7+Molinia now dominates this section. This vegetation is located on slightly raised ground running SW-NE which is likely to be a mineral ridge which, has emerged due to further subsidence.
- The marginal ecotope section to the south of **C4** on Clara West seems slightly larger than in 2004. However, the 2005 ortho-images show this area to be much darker than the surrounding area. This is likely to indicate that this area was dry and not accurately mapped in the 2004 survey.

Other changes

- The 2009 ecotope map illustrates that the following active peat forming areas, previously considered to be isolated, are linked to other peat forming areas. This improvement in the ecotope map is likely to be a result of a more detailed survey in 2009 rather than an actual change in the vegetation since the previous survey was conducted. The following connections were noted:
 - a) Clara East: **Sc10-F6-F11-F12** and **Sc15** in the western section; **Sc13-F9** middle section.
 - b) Clara West **Sc2** and **Sc3** now connected to **Sc1**.
- Infilling processes seem to continue in the soaks located in the northeast section of Clara East as changes in **F13j** (currently infilled) indicate.
- The 2009 map illustrates considerable changes along the northeast section of Clara East. These changes are the result of more accurate mapping in the 2009 survey and the re-allocation of some areas previously mapped as sub-central ecotope (e.g. 7/9+P described as transitional sub-central sub-marginal) to sub-marginal ecotope.
- A large open water pond has developed to the northwest of **C3** (GR: 224196, 230334) see photograph 1.

Quadrats analysis

No major changes in vegetation have taken place within those quadrats recorded in 2004 that were re-surveyed in 2009 (see table 7.5).

Although high accuracy GPS equipment was used during the 2004 and 2009 surveys, the devices still only allow up to 0.5m accuracy. Therefore, this possible discrepancy in the location of quadrats may justify certain differences in the vegetation described.

Table 7.5 Assessment of changes in individual Active Raised Bog areas

Area	Quadrats	Trend	Comment	Quadrats analysis
C1	Qc4	Stable	Very similar extent to 2004	Qc4 - No major changes: slightly higher pools cover, higher <i>S. cuspidatum</i> cover.
C2	Absent	Stable	Slightly smaller than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	
C3	Qc1, Qc3	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary. A large open water pond has developed to the northwest of C3 (GR: 224196, 230334) see photograph 1.	Qc1 - No major changes: slightly smaller cover of <i>Eriophorum angustifolium</i> and <i>Sphagnum cuspidatum</i> . Higher cover of <i>Calluna vulgaris</i> . Qc3 - No major changes: higher pools cover, increased <i>Sphagnum magellanicum</i> and decreased <i>S. papillosum</i> cover, smaller <i>S. cuspidatum</i> cover.
C4	Absent	Stable	Very similar extent to 2004. Northern section damaged by 2008 fire event.	
C5	Absent	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and reallocation of vegetation deemed active flush in 2004 to central ecotope in 2009. Nonetheless, this area may also be getting wetter in conjunction with other sections along southern margin of Clara West.	

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C6	Absent	Stable	Similar extent to 2004.	
C7	Absent	Stable	Similar extent to 2004.	
C8	Absent	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	
C9	Qc6	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	Qc6 - New 2009 quadrat
C10	Absent	Stable	Similar extent to 2004.	
C11	Absent	Stable	Shape slightly different to 2004; This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	
C12	Qc2	Stable	Very similar extent to the 2004 survey.	Qc2 - No major changes: higher pools cover, higher <i>S.cuspidatum</i> cover.
C13 (F14)	Absent	Stable	Very similar extent to the 2004 survey. Previously mapped as central ecotope is now considered to be a soak.	
C14	Qc5	Stable	Slightly smaller than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	Qc5 - No major changes: higher pools cover, higher <i>S.cuspidatum</i> , <i>S. magellanicum</i> cover.
C15	Absent	Stable	Very similar extent to the 2004 survey. Located to the southwest of original 2004 location, due to mapping error in previous survey.	
C16	Absent	Stable	Slightly smaller than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	
C17	Absent	Expanding	Slightly larger. This example of central ecotope was described as newly formed in 2004 and may be expanding.	
C18	Absent	Unknown	This small section of central ecotope was not reported in 2004.	
C19	Absent	Stable	This section of central ecotope was not	

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			mapped in 2004. A very similar description was given in 2004 and thus likely to be the result of re-allocating this area to a different vegetation ecotope in 2009.	
C20	Absent	Newly developed	Evidences indicate that this area may be getting wetter after the blocking of drainage.	
Sc1	Qsc4, Qsc9	Expanding	The southern section of Sc1 to the south of large mineral mound (GR: 223798/229888) is getting wetter. As well as area to the southwest of F2 (GR: 224004/229868).	Qsc4 - No major changes: slightly higher <i>S. magellanicum</i> , increase on hummocks cover decrease on pools. Qsc9 – New 2009 quadrat
Sc2	Absent	Stable	Slightly larger than in 2004 and now linked to Sc1 to the southeast, This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary. No data was recorded in 2004 in the area currently linking both sub-central sections.	
Sc3	Qsc5	Stable	Slightly larger than in 2004 and now linked to Sc1 to the southeast. This is likely to be the result of re-allocating some of this area to a different vegetation ecotope in 2009. Complex 9/7 + P, which was allocated to sub-marginal ecotope, was recorded in the area currently connecting both sub-central areas. Complex 9/7/10+P (sub-central ecotope) was recorded in the same location in 2009. These two complexes are only slightly different and the change is likely to be the result different vegetation interpretation and more detailed mapping in the 2009 survey.	Qsc5 - No major changes: slightly higher <i>Sphagnum</i> cover, smaller <i>Eriophorum angustifolium</i> cover.
Sc4	Qsc8	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocating some sections of this area to a different vegetation ecotope in 2009. This	Qsc8 - New 2009 quadrat

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			area was described as borderline sub-marginal/sub-central in 2004.	
Sc5	Absent	Decreased	This area was considered to have become drier and active peat forming vegetation losses were reported for the 1993-2004 period by Fernandez <i>et al.</i> (2005). More accurate mapping in the 2009 survey and re-allocation of some of this area to a different vegetation ecotope (sub-marginal) in 2009 may partially justify the reduction in extent (This area was described as borderline sub-marginal/sub-central in 2004). Nonetheless, actual changes are likely to be taking place here.	
Sc6	Qsc2	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocation of some of this area to a different vegetation ecotope (sub-central).	Qsc2 - No major changes: higher <i>S. magellanicum</i> and <i>S. cuspidatum</i> cover.
Sc7	Absent	Decreased	As above	
Sc8	Qsc3	Stable	Very similar extent to the 2004 survey	Qsc3 – No major changes: slightly smaller pools cover, slightly higher <i>S. magellanicum</i> , <i>Rhynchospora alba</i> , <i>Eriophorum vaginatum</i> , <i>Calluna vulgaris</i> cover.
Sc9	Qsc1	Stable	Very similar extent to the 2004 survey	Qsc1 - No major changes: slightly higher <i>S. magellanicum</i> , <i>S. papillosum</i> cover, <i>Rhynchospora alba</i> , <i>Eriophorum vaginatum</i> , <i>Calluna vulgaris</i> cover.
Sc10	Absent	Expanding	This area seems to be expanding towards the southwest. This area is now mapped as connected to F6 .	
Sc11	Absent	Stable	Slightly smaller than in 2004 (previously Sc11) This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocation of	

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			some of this area (complex 7/9+P described as poor sub-central ecotope in 2004) to a different vegetation ecotope (sub-marginal) in 2009.	
Sc12	Absent	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocation of some of this area (complex 7/9+P described as poor sub-central ecotope in 2004) to a different vegetation ecotope (sub-marginal) in 2009.	
Sc13	Qsc12	Expanding	This area seems to be getting wetter as the result of blocking of drainage. This area is now mapped as connected to F9 .	Qsc12 – New 2009 quadrat
Sc14	Qsc11	Stable	Slightly larger than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocation of some of this area (complex 7/9+P described as poor sub-central ecotope in 2004) to a different vegetation ecotope (sub-marginal) in 2009	Qsc11 – New 2009 quadrat
Sc15	Absent	Stable	Linked to the north to F12 , F11 and F6 . This may be the result of higher mapping accuracy in 2009.	
Sc16	Absent	Stable	Slightly smaller than in 2004. This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary.	
Sc17	Absent	Newly developed	This area was not thoroughly surveyed in 2004. Re-wetting is likely to be taking place in this location as a result of blocking of drains.	
Sc18	Absent	Newly developed	Re-wetting is likely to be taking place in this location as a result of blocking of drains This area is corresponds to an area previously mapped by Kelly (1993) as sub-central (with drainage) and sub-marginal complexes (3/2/7 and 2/7) were recorded in this location in 2004.	

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Sc19	Qsc7	Newly developed	Re-wetting is likely to be taking place in this location as a result of blocking of drains and construction of peat dams adjacent to the track.	Qsc7 – New 2009 quadrat
Sc20	Absent	Expanding	Sub-central ecotope is much larger than reported in 2004. Southern section of Clara West seems to be getting wetter to the south of Sc1 .	
Sc21	Qsc10	Newly developed	This area is getting wetter and active peat forming vegetation has developed after blocking of drainage.	Qsc10 - New 2009 quadrat
Sc22	Absent	Newly mapped	This area was not thoroughly surveyed in 2004. This section is likely to have developed as the result of blocking of drains. Similar processes recorded in other section along western section of Clara East.	
Sc23	Absent	Expanding	This area seems to be getting wetter as the result of blocking of drains.	
Sc24	Absent	Expanding	This area seems to be getting wetter as the result of blocking of drains. The occurrence of a medium size central ecotope within Sc24 also indicate some improvement on habitat quality	
Sc25	Absent	Newly mapped	This area seems to be getting wetter as the result of blocking of drains.	
Sc26	Absent	Newly mapped	This area seems to be getting wetter as the result of blocking of drains.	
Sc27	Absent	Stable	Slightly smaller than in 2004 (previously Sc11). This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocation of some of this area (complex 7/9+P described as poor sub-central ecotope in 2004) to a different vegetation ecotope (sub-marginal) in 2009.	
Sc28	Absent	Expanding	This area seems to be getting wetter as the result of blocking of drainage.	
Sc29	Absent	Stable	This area (previously Sc11) seems to be	

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			getting wetter as the result of blocking of drainage.	
Sc30	Absent	Stable	Slightly smaller than in 2004 (previously Sc11). This is likely to be due to more accurate mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocation of some of this area (complex 7/9+P described as poor sub-central ecotope in 2004) to a different vegetation ecotope (sub-marginal) in 2009.	
Sc31	Absent	Newly developed	Re-wetting is taking place in this section where peat dams were built.	
Sc32	Absent	Stable	Not major changes. Previously mapped as active flushes and now re-allocated to sub-central ecotope.	
Sc33	Absent	Stable	Not major changes. Previously mapped as active flushes and now re-allocated to sub-central ecotope.	
Sc34	Absent	Unknown	This specific area was not surveyed in 2004.	
Sc35	Absent	Stable	Very similar extent to the 2004 survey.	
F1	Absent	Stable	Slight changes to the south east (GR: 223617/230014). May be indicating further subsidence along the southern section of Clara West.	
F2	Absent	Stable	Southern section likely to be getting wetter.	
F3	Qf1	Stable	An area of active peat forming flush was noted to the north adjacent to C3 .	Qf1 – New 2009 quadrat
F4	Absent	Stable	A small section of F4a was considered to be active in 2009. This is likely to be the result of re-allocating this area to inactive vegetation in 2009	
F5	Absent	Stable	Re-wetting processes are likely to be taking place as the southern section is now considered active.	
F6	Absent	Expanding	F6 is slightly larger. Some changes are likely to be due to more accurate	

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			mapping in the 2009 survey, which, has resulted in an improved ecotope boundary and re-allocating some of this area to active peat forming vegetation in 2009. Nonetheless, this section of Clara East seems to be getting wetter as a result of blocking of drainage.	
F7	Absent	Expanding	Slightly large to the area mapped in 2004, the surrounding High Bog vegetation consists now of sub-central ecotope (Sc21) and this section of the bog is getting wetter.	
F8	Absent	Drier	Slightly drier than in 2004 as the absence of <i>Sphagnum cuspidatum</i> pools recorded in 2004 indicate.	
F9	Absent	Expanding	This area seems to be getting wetter as the result of blocking of drainage. This area is now mapped as connected to Sc13 .	
F11	Absent	Wetter	F11 was not mapped in the right location in 2004. This flush which was deemed inactive in 2004 is now considered active. It is linked to other active peat forming areas such as Sc10 to Sc15 through F6 and F12 .	
F12	Absent	Stable	F12 is now considered to contain a section deemed to be active peat forming. Also part of a larger active peat forming complex (Sc10,Sc15,F6 and F12)	
F13 (a-j)	Qf2 (in F13a)	Stable	In-filling process taking place within these soaks. F13j is now reported as infilled whereas was mapped as open water in 2004.	Qf2 – New 2009 quadrat
F14	Absent	Stable	Formerly mapped as C13 . It is now considered a soak and thus named F14 .	
F15	Absent	Unknown	This newly mapped active flush is located within Sc27	
F16	Absent	Stable	A small section of the original F16 is now	

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			mapped as active peat forming. This is likely to be the result of re-allocating some of this area to a different vegetation type in 2009.	
F17	Absent	Unknown	This active flush surrounds F13a	
F18	Absent	Stable	Found within C12 remains similar to 2004	
BW1 BW2 BW3	Absent	Stable	Similar extent to 2004.	

8. CONCLUSIONS

The 2009 survey indicates that there has been a slight increase (11.16ha, 11.12%) in the extent of Active Raised Bog vegetation in the 2004 to 2009 period. This increase is the result of expansion and/or regeneration of active peat forming vegetation induced by restoration work carried out in previous years and improvement in ecotope boundaries as a result of more accurate mapping in the 2009 survey.

In **Clara West**, Active Raised Bog has increased by 9.3ha (13.17%) and figures illustrate a relatively large increase in the extent of both central and sub-central ecotopes. A large proportion of the increase in sub-central ecotope is the result of development of new Active Raised Bog habitat along the eastern section of Clara West (**Sc17, 18 and 19**). This has been induced by drain blocking and dam construction. The extent of sub-central ecotope has changed along the northern section of Clara West (**Sc2, 3 and 4**); this is the result of more accurate mapping in 2009 and re-allocating some sections of previously mapped sub-central / sub-marginal transitional complexes (e.g. 9/7/10+P (sub-central) and 9/7+P (sub-marginal)) to a different vegetation type.

Central ecotope has also slightly increased within Clara West; this has been particularly significant within **C5**. This increase is due, in part, to the re-allocation of certain sections to different vegetation types. However, re-wetting seems to be taking place along the southern section of the bog and thus, central ecotope is likely to have expanded in this location.

Ongoing subsidence, induced by drainage associated with peat cutting and cutover drains along the southern section of Clara West, has played a major role in the increase of active peat forming vegetation within Clara West. Subsidence of 10cm was observed at a benchmark immediately south of Shanley's Lough between January 1996 and July 1999 (Schouten, 2002). This subsidence to the south of Clara West is likely to be altering part of the hydrological functioning of Clara West. This may be leading to a higher water flow towards the south, encouraging the expansion of active peat forming vegetation and the development of open water ponds (Fernandez *et al*, 2005). Although this phenomenon can be seen as positive, further subsidence will lead to irreversible losses of active areas as the result of increases in surface slope and decrease in flow path lengths. According to Schouten (2002) on slopes greater than 1.5-2% the bog become haplotelmic (i.e. devoid of acrotelm) and therefore newly formed Active Raised Bog vegetation may be lost. Furthermore, the impact of changes in the hydrological functioning of Clara Bog on active peat forming vegetation in more northern and middle sections is uncertain as the on-going losses of sub-central ecotope to the north-west (**Sc5**) indicates. Changes in the bog hydrological system caused by drainage are also likely to irreversible and negatively impact the diverse and fragile vegetation communities at Shanley's Lough soak.

No major changes in the overall extent of degraded Raised Bog vegetation was noted in Clara West in the 2004 to 2009 period. However, evidence of further drying out processes and expansion of degraded Raised Bog was noted along the southern section of Clara West

(i.e. expansion of sub-marginal ecotope between **C11** and **C12** on top of an area likely to correspond to a mineral ridge; expansion of marginal and sub-marginal ecotope around and to the north of the large mineral mound on the south of Clara West). These small changes in degraded Raised Bog vegetation are rather significant and confirm the impacting nature of drainage and peat cutting along the southern boundary of Clara West.

Active Raised Bog has increased by 1.86ha (6.25%) in **Clara East**. Although the overall sub-central, central ecotopes figures do not indicate significant changes, this section of Clara Bog has seen the biggest increase in active peat forming vegetation. Major changes in the extent and distribution of sub-central ecotope have occurred as a result of drain blocking throughout the entire High Bog (**Sc10, 13, 21-26, 28, 29** and **31**). Areas of central ecotope (**C17** and **20**) have also expanded, or developed as a result of drains being blocked. The northeast section of Clara East has seen considerable changes in the extent of sub-central ecotope. This is mainly due to re-allocating some transitional sub-marginal /sub-central complex (7/9+P (sub-central) to a different vegetation type (sub-marginal) and more accurate mapping rather than any actual change in the vegetation.

The 2009 survey has considerably improved the ecotope map of Clara Bog. Some areas of active peat forming vegetation depicted as isolated in 2004 are now considered to be linked to each other in both sections of Clara. This indicates certain hydrological connections between the two sections, which should help to further understand the hydrological functioning on Clara Bog.

Overall, restoration works carried out in Clara Bog have had a very significant positive effect on Active Raised Bog habitat vegetation. It has allowed the development of new active peat forming vegetation on both sections of Clara. This is happening despite ongoing negative impacts caused by drainage, peat cutting (particularly along the southern section of the bog) and repetitive fires. Nevertheless, the impact of these negative activities should not be underestimated; the expansion of active peat forming vegetation along the southern section of Clara has been coupled with further subsidence and drying out processes (i.e. expansion of drier mounds and ridges). This may lead to irreversible losses of Annex I, Active Raised Bog habitat at Clara Bog.

9. REFERENCES

- Bell, J. 1991. *A Study of the Hydrological Effects of a Bog Road, Clara Bog, County Offaly, Ireland*. M.SC thesis, Dept. of Civil Engineering, Imperial College, London.
- Cross, J. R. 1990. *The Raised Bogs of Ireland: their Ecology, Status and Conservation*. Report to the Minister of State at the Department of Finance.
- Fernandez, F., Fanning, M., McCorry, M. and Crowley, W. 2005. *Raised Bog Monitoring Project 2004-05*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.
- Fernandez, F., MacGowan F., Crowley, W., Farrell, M., Croal, Y., Fanning, M. & McKee, A. 2006. *Assessment of impacts of turf cutting on designated Raised Bogs 2003-06*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage Local Government, Dublin.
- Kelly, M. L. 1993. *Hydrology, Hydrochemistry and Vegetation of Two Raised Bogs in Co. Offaly*. Ph. D-thesis, Trinity College Dublin.
- Kelly, L., Doak, M. and Dromey, M. 1995. *Raised Bog Restoration Project: An Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland*. Unpublished report, National Parks & Wildlife, Department of Environment, Heritage and Local Government, Dublin.
- Kelly, L. and Schouten, M. G. C. 2002. *Vegetation*. In: M. G. C. Schouten (Ed.), *Conservation and Restoration of Raised Bogs: Geological, Hydrological and Ecological Studies*. pp.110-169. Department of Environment and Local Government, Dublin, Ireland/Staatabosbeheer, The Netherlands.
- Malone, C. 2009. *Map of Clara fire from 2008*. [E-mail]. Message to: F. Fernandez. 10 November 2009
- O' Mahony, C. draft. *Conservation Plan for Natura 2000 site. Clara Bog cSAC 572, Co. Offaly. Draft II Consultation*. Period of Plan: 1999-2004. National Parks & Wildlife, Department of Environment, Heritage and Local Government, Dublin.
- Streefkerk, J. K and Douglas, C. 1994. *Management Plan for Clara East: blocking superficial drains on the High Bog*. Internal Report for the National Parks and Wildlife Service, Dublin.
- Van der Schaaf, S. 2002. Bog Hydrology. In: M. G. C. Schouten (Ed.), *Conservation and Restoration of Raised Bogs: Geological, Hydrological and Ecological Studies*. pp.54-77. Department of Environment and Local Government, Dublin, Ireland/ Staatabosbeheer, The Netherlands.
- Van Tatenhove, F. and Van der Meer, J. 1990. *The Quaternary Geology of Clara Bog and Raheenmore, Co. Offaly, Ireland*. Preliminary mapping of Superficial Deposits. University of Amsterdam.

Appendix I Community complexes

Vegetation community complexes were identified according to the dominance of one to three plant species that characterise each community; additionally the abundance of pools, *Myrica gale* or *Molinia caerulea* was also noted. The following community complex were reported and mapped as part of the 2009 survey, based on Kelly (1993).

Community complex code	Vegetation community complex type
1	<i>Calluna vulgaris</i> (face-bank)
2	<i>Trichophorum caespitosum</i> dominated
3	<i>Carex panicea</i> dominated
4	<i>Rhynchospora alba</i> dominated
6	<i>Narthecium ossifragum</i> dominated
7	<i>Calluna vulgaris</i> dominated
7a	<i>Eriophorum angustifolium</i> dominated
9	<i>Eriophorum vaginatum</i> dominated
9a	<i>Eriophorum angustifolium</i> dominated
10	<i>Sphagnum</i> dominated
14	Hummock/hollow frequent pool complex
15	Hummock/hollow scattered pool complex

Appendix II Photographical Records

Photograph Number	File Number	Aspect	Type	Feature	Date
1	150-5170	E	Overview	Open water pond	25/08/2009
2	150-5175	NA	Detail	Qsc9	26/08/2009
3	150-5176	SW	Overview	Qsc9	26/08/2009
4	150-5168	SE	Overview	Qsc7	25/08/2009
5	150-5169	NA	Detail	Qsc7	25/08/2009
6	150-5173	E	Overview	Qsc8	25/08/2009
7	150-5174	NA	Detail	Qsc8	25/08/2009

Appendix III Quadrats

SURVEY DATE	09/2004	24/08/2009	09/2004	26/08/2009
COMPLEX_NA	15	14	14	14
GPS READING	224380, 230320	224380, 230320	223171, 229865	223171, 229865
ECOTOPE_TY	Central	Central	Central	Central
QUADRAT NAME	Qc1	Qc1	Qc2	Qc2
FIRMNESS	Quaking	Quaking	Quaking	Quaking
CRACKING	No	No	No	No
BOG BURST	No	No	No	No
SLOPE	Flat	Depression	Flat	Flat
DRAINS	no drains	no drains	no drains	no drains
BURNT	2000?	No	NA	No
TREND	Stable	Unknown	NA	Stable
ALGAL HOLLOWES	0	0	0	0
ALGAL POOL	0	0	0	0
BARE PEAT	0	0	0	0
POOLS COVER	>70	60	30	60
POOLS TYPE	Regular pools	Inter-connecting	Inter-connecting	Inter-connecting
MICRO TOPOGRAPHY	Pool/lawns/humm/holl	Pool/lawns/humm/holl	low hums, hols, pool	Pool/lawns/humm/holl
COMMUNITY				
S. CAP HUMMOCKS	10	10	5	10
S. IMBRIC HUMMOCKS	< 5	< 5	5	5
LEUCOBRYUM HUMMOCKS	0	0	0	0
TRICHOPHORUM TUSsock	0	0	0	0
TRICHOPHORUM FLATS	0	0	0	0
S. PAP HUMMOCKS	15	0	5	10
S. PAP HOLLOWES	NA	0	NA	10
S. MAG HUMMOCKS/LAWNS/HOLLOWES	5	10	25	30
S. MAG HABITATS	lawns & hollows	lawns & hollows	lawns & hollows	lawns & hollows
S. CUSPIDATUM/E. ANG POOLS	40	30	5	60
R. FUSCA HOLLOWES	0	0	0	0
R. ALBA HOLLOWES	< 5	0	5	5
E. VAGINATUM HOLLOWES	10	0	0	0
NARTHECIUM	< 5	0	5	5
NARTHECIUM LAWNS	hollows & lawns	hollows & lawns	lawns	lawns
S. MAG / S. CUSP POOLS	< 5	5	15	60
S. SUBNITENS	0	0	0	0
S. AURIC POOLS	5	0	0	0
S. FUSCUM HUMMOCKS	0	0	0	0
S. CUSP	40	25	15	30
SPHAGNUM POOLS/LAWNS	60	50	40	70
SPHAGNUM HUMMOCKS	20	20	25	20
SPHAGNUM HOLLOWES	NA	10	NA	5
TOTAL SPHAGNUM COVER	80	80	70	90
E. ANGUS	25	5	5	10
QUALITY INDICATORS				

Clara Bog High Bog Ecological Survey

HUMMOCK INDICATORS	<i>S. imbricatum</i>		<i>S. imbricatum</i>	<i>S imbricatum</i>
POOLS INDICATORS	<i>S. cuspidatum, S. auriculatum</i>	<i>S. cuspidatum, S. auriculatum</i>	<i>S. cusp</i>	<i>S. cuspidatum</i>
CLADONIA PORTENTOSA	0	0	5	1
CLADONIA COVER	0	0	5	1
TRICHOPHORUM TUSSOCKS	0	0	0	0
NARTHECIUM ABUNDANT	0	0	0	5
E. VAGINATUM TUSSOCKS	0	5	0	0
CAREX PANICEA	0	0	0	0
S. MAGELLANICUM ABUNDANT	10	10	0	30
CLADONIA FLOERKEANA	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0
TEAR PATTERN	0	0	0	0
CALLUNA COVER	5	25	15	5
CALLUNA HEIGHT	0.2	0.1	0.2	0.3
OTHER DETAILS				
OTHER SPECIES		Birch sapling 0.4m	<i>Erica tetralix</i>	<i>A. polifolia, D. anglica, V. oxycoccus</i>
COMPLEX VARIATIONS				
SIMILAR DESCRIPTION				
OTHER DETAILS	<i>S.papillosum</i> in lawns and pools		<i>S.papillosum</i> in hollows	

Clara Bog High Bog Ecological Survey

SURVEY DATE	09/2004	24/08/2009	09/2004	26/08/2009
COMPLEX_NA	14	14	10/15	10/15
GPS READING	224325, 230283	224325, 230283	224119, 230643	224119, 230643
ECOTOPE_TY	Central	Central	Central	Central
QUADRAT NAME	Qc3	Qc3	Qc4	Qc4
FIRMNESS	Quaking	Quaking	Quaking	Quaking
CRACKING	No	No	No	No
BOG BURST	No	No	No	No
SLOPE	Flat	Depression	Depression	Depression
DRAINS	no drains	no drains	no drains	no drains
BURNT	NA	No	NA	No
TREND	NA	Stable	NA	Unknown
ALGAL HOLLOWES	0	0	0	
ALGAL POOL	0	0	0	0
BARE PEAT	0	0	0	0
POOLS COVER	15	40	20	40
POOLS TYPE	Regular pools	Inter-connecting	tear pools	Inter-connecting
MICRO TOPOGRAPHY	high hum, holl, pool	High hummocks/pools	high hum, holl, pool	Low Hummocks/pools
COMMUNITY				
S. CAP HUMMOCKS	10	10	5	5
S. IMBRIC HUMMOCKS	< 5	0	0	0
LEUCOBRYUM HUMMOCKS	0	0	0	0
TRICHOPHORUM TUSsock	0	0	0	0
TRICHOPHORUM FLATS	0	0	0	0
S. PAP HUMMOCKS	25	10	0	0
S. PAP HOLLOWES	NA	10	NA	0
S. MAG HUMMOCKS/LAWNS/HOLLOWES	10	30	60	30
S. MAG HABITATS	lawns & hollowes	lawns & hollowes	lawns & hollowes	lawns & hollowes
S. CUSPIDATUM/E. ANG POOLS	0	10	0	30
R. FUSCA HOLLOWES	0	0	0	0
R. ALBA HOLLOWES	5	0	5	5
E. VAGINATUM HOLLOWES	5	0	5	0
NARTHECIUM	5	0	< 5	0
NARTHECIUM LAWNS	0	0	0	0
S. MAG / S. CUSP POOLS	0	50	0	20
S. SUBNITENS	0	0	0	0
S. AURIC POOLS	0	0	0	0
S. FUSCUM HUMMOCKS_	0	0	0	0
S. CUSP	15	20	15	40
SPHAGNUM POOLS/LAWNS	30	60	> 70	70
SPHAGNUM HUMMOCKS	30	20	20	20
SPHAGNUM HOLLOWES	NA	0	0	0
TOTAL SPHAGNUM COVER	70	80	90	90
E. ANGUS	< 5	5	< 5	5
QUALITY INDICATORS				
HUMMOCK INDICATORS		<i>S imbricatum</i>		

Clara Bog High Bog Ecological Survey

POOLS INDICATORS	<i>S. cuspidatum</i>	<i>S. cuspidatum</i>		<i>S. cuspidatum</i>
CLADONIA PORTENTOSA	< 5%	1	present	0
CLADONIA COVER	< 5	1	present	0
TRICHOPHORUM TUSSOCKS	0	0	0	0
NARTHECIUM ABUNDANT	0	5	0	0
E. VAGINATUM TUSSOCKS	0	30	0	5
CAREX PANICEA	0	0	0	0
S. MAGELLANICUM ABUNDANT	0	30	60	30
CLADONIA FLOERKEANA	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0
TEAR PATTERN	0	0	0	0
CALLUNA COVER	20	20	< 5	10
CALLUNA HEIGHT	0.4	0.3	0.2	0
OTHER DETAILS				
OTHER SPECIES		<i>Rhynchospora alba</i> 20%, <i>D. anglica</i> , <i>D. rotundifolia</i> , <i>V. oxycoccus</i>	<i>Erica tetralix</i> on lawns	
COMPLEX VARIATIONS				
SIMILAR DESCRIPTION				
OTHER DETAILS	<i>S.papillosum</i> in hummocks		<i>S.papillosum</i> in hummocks and hollows	

Clara Bog High Bog Ecological Survey

SURVEY DATE	09/2004	01/09/2009	26/08/2009	09/2004	25/08/2009
COMPLEX_NA	10/15	10/15	15	9/7/10	9/7/10
GPS READING	225875, 230095	225875, 230095	223627,230263	224298, 230182	224298, 230182
ECOTOPE_TY	Central	Central	Central	Sub-central	Sub-central
QUADRAT NAME	Qc5	Qc5	Qc6	Qsc1	Qsc1
FIRMNESS	Quaking	Quaking	Quaking	Firm-soft	Very soft
CRACKING	No	No	No	No	No
BOG BURST	No	No	No	No	No
SLOPE	Depression	Depression	Gentle slope	Flat	Flat
DRAINS	no drains	no drains	no drains	no drains	no drains
BURNT	NA	No	No	NA	No
TREND	NA	Unknown	Unknown	NA	Stable
ALGAL HOLLOWES	0	0	0	0	0
ALGAL POOL	0	0	0	0	0
BARE PEAT	0	0	0	0	0
POOLS COVER	50	100	20	0	0
POOLS TYPE	Regular Pools	Regular Pools	Inter-connecting	Absent	Absent
MICRO TOPOGRAPHY	low hums, hols, pool	Pools/lawns	High Humh/holl/pool	low hums and hols	Low/hummocks/hollows
COMMUNITY					
S. CAP HUMMOCKS	10	0	5	5	20
S. IMBRIC HUMMOCKS	0	0	0	0	0
LEUCOBRYUM HUMMOCKS	0	0	0	0	0
TRICHOPHORUM TUSSECK	0	0	0	0	0
TRICHOPHORUM FLATS	< 5	0	0	0	0
S. PAP HUMMOCKS	5	0	30	0	0
S. PAP HOLLOWES	NA	0	0	0	10
S. MAG HUMMOCKS/LAWNS/HOLLOWES	15	50	10	0	20
S. MAG HABITATS	lawns & hollows	lawns & hollows	NA	NA	NA
S. CUSPIDATUM/E. ANG POOLS	< 5	25	5	0	0
R. FUSCA HOLLOWES		0	0	0	0
R. ALBA HOLLOWES	< 5	0	0	0	5
E. VAGINATUM HOLLOWES	15	0	5	10	20
NARTHECIUM	10	0	0	5	5
NARTHECIUM LAWNS	NA	0	0	0	0
S. MAG / S. CUSP POOLS	20	100	5	0	0
S. SUBNITENS	0	0	0	0	0
S. AURIC POOLS	5	0	0	0	0
S. FUSCUM HUMMOCKS	0	0	0	0	0
S. CUSP	10	50	10	0	0
SPHAGNUM POOLS/LAWNS	50	100	20	0	0
SPHAGNUM HUMMOCKS	10	0	40	40	30
SPHAGNUM HOLLOWES	NA	0	0	NA	20
TOTAL SPHAGNUM COVER	60	100	60	40	50
E. ANGUS	5	2	5	0	0
QUALITY INDICATORS					
HUMMOCK INDICATORS					

Clara Bog High Bog Ecological Survey

POOLS INDICATORS	<i>S. cuspidatum</i> , <i>S. auriculatum</i>	<i>S. cuspidatum</i>	<i>S. cuspidatum</i>		
CLADONIA PORTENTOSA	5	0	2	1	1
CLADONIA COVER	5	0	0	1	1
TRICHOPHORUM TUSsocks	0	0	0	0	5
NARTHECIUM ABUNDANT	NA	5	0	0	5
E. VAGINATUM TUSsocks	NA	2	0	0	20
CAREX PANICEA	5	0	0	0	0
S. MAGELLANICUM ABUNDANT	15	50	10	0	20
CLADONIA FLOERKEANA	0	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0	0
TEAR PATTERN	0	0	0	0	0
CALLUNA COVER	10	5	25	10	40
CALLUNA HEIGHT	0.3	0	0	0.2	0.3
OTHER DETAILS					
OTHER SPECIES	<i>Menyanthes trifoliata</i>	<i>M. trifoliata</i> , <i>A. polifolia</i> , <i>V. oxycoccus</i> , <i>D. rotundifolia</i>			
COMPLEX VARIATIONS					
SIMILAR DESCRIPTION					
OTHER DETAILS	<i>S. papillosum</i> in hollows / lawns		New quadrat		

Clara Bog High Bog Ecological Survey

SURVEY DATE	09/2004	25/08/2009	09/2004	24/08/2009
COMPLEX_NA	10/9	7/9/10+P	9/10	9/10
GPS READING	223915, 230730	223915, 230730	224524, 230494	224524, 230494
ECOTOPE_TY	Sub-central	Sub-central	Sub-central	Sub-central
QUADRAT NAME	Qsc2	Qsc2	Qsc3	Qsc3
FIRMNESS	Very soft	Quaking	Very soft	Very soft
CRACKING	No	No	No	No
BOG BURST	No	No	No	No
SLOPE	Flat	Flat	Steep slope	Gentle slope
DRAINS	no drains	no drains	no drains	no drains
BURNT	NA	No	NA	No
TREND	NA	Unknown	Stable	Unknown
ALGAL HOLLOWES	0	0	0	0
ALGAL POOL	0	0	0	0
BARE PEAT	0	0	0	0
POOLS COVER	10	10	10	5
POOLS TYPE	Regular Pools	Regular Pools	inter-connecting pools	Regular Pools
MICRO TOPOGRAPHY	low hums, hols, pool	Pool/lawns/humm/holl	low hums, hols, pool	Low/hummocks/hollows
COMMUNITY				
S. CAP HUMMOCKS	10	20	10	20
S. IMBRIC HUMMOCKS	0	0	< 5	0
LEUCOBRYUM HUMMOCKS	0	0	0	0
TRICHOPHORUM TUSsock	0	0	0	0
TRICHOPHORUM FLATS	0	0	0	0
S. PAP HUMMOCKS	0	0	10	20
S. PAP HOLLOWES	NA	20	NA	0
S. MAG HUMMOCKS/LAWNS/HOLLOWES	40	30	10	0
S. MAG HABITATS	lawns & hollows	lawns & hollows	lawns & hollows	0
S. CUSPIDATUM/E. ANG POOLS	0	10	present	0
R. FUSCA HOLLOWES	0	0	0	0
R. ALBA HOLLOWES	< 5	5	5	20
E. VAGINATUM HOLLOWES	5	1	5	20
NARHECIUM	5	5	0	0
NARHECIUM LAWNS	NA	0	0	0
S. MAG / S. CUSP POOLS	0	0	0	0
S. SUBNITENS	0	0	0	0
S. AURIC POOLS	0	0	5	NA
S. FUSCUM HUMMOCKS	0	0	0	0
S. CUSP	0	10	10	5
SPHAGNUM POOLS/LAWNS	40	30	20	5
SPHAGNUM HUMMOCKS	40	30	20	30
SPHAGNUM HOLLOWES	NA	10	NA	5
TOTAL SPHAGNUM COVER	80	70	40	40
E. ANGUS	< 5	10	5	5
QUALITY INDICATORS				

Clara Bog High Bog Ecological Survey

HUMMOCK INDICATORS			<i>S. imbricatum</i>	
POOLS INDICATORS		<i>S. cuspidatum</i>	<i>S. cuspidatum, S. auriculatum</i>	<i>S. cuspidatum</i>
CLADONIA PORTENTOSA	< 5	0	< 5	5
CLADONIA COVER	< 5	0	< 5	5
TRICHOPHORUM TUSSOCKS	0	0	0	0
NARTHECIUM ABUNDANT	NA	5	0	0
E. VAGINATUM TUSSOCKS	0	0	0	10
CAREX PANICEA	0	0	0	0
S. MAGELLANICUM ABUNDANT	0	30	0	0
CLADONIA FLOERKEANA	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0
TEAR PATTERN	0	0	0	0
CALLUNA COVER	15	30	15	20
CALLUNA HEIGHT	0.2	0.3	0.2	0.2
OTHER DETAILS				
OTHER SPECIES		<i>M. trifoliata, D. anglica</i>		
COMPLEX VARIATIONS				
SIMILAR DESCRIPTION				
OTHER DETAILS	<i>S. papillosum</i> in hummocks and hollows		<i>S. papillosum</i> in hummocks and hollows	

Clara Bog High Bog Ecological Survey

SURVEY DATE	09/2004	26/08/2009	09/2004	26/08/2009	09/2004
COMPLEX_NA	7/9/10	7/9/10	10/4	4/10+P	9/7 + P
GPS READING	223119, 230077	223119, 230077	223127, 230382	223127, 230382	226015, 230407
ECOTOPE_TY	Sub-central	Sub-central	Sub-central	Sub-central	Sub-central
QUADRAT NAME	Qsc4	Qsc4	Qsc5	Qsc5	Qsc6
FIRMNESS	Very soft	Soft	Very soft	Quaking	very soft
CRACKING	No	No	No	No	no
BOG BURST	No	No	No	No	no
SLOPE	Flat	Gentle slope	Flat	Gentle slope	depression
DRAINS	no drains	no drains	no drains	no drains	no drains
BURNT	NA	No	NA	No	
TREND	NA	Unknown	Drier	Unknown	Stable
ALGAL HOLLOWS	0	0	< 5	0	0
ALGAL POOL	0	0	0	0	0
BARE PEAT	0	0	0	0	0
POOLS COVER	< 5	5	15	30	50
POOLS TYPE	Regular Pools	Regular Pools	Regular Pools	Inter-connecting	Regular Pools
MICRO TOPOGRAPHY	low hums and hols	Low/hummocks/hollows	low hums, hols, pool	Low Hummocks/pools	low hums, hols, pool
COMMUNITY					
S. CAP HUMMOCKS	10	30	5	5	10
S. IMBRIC HUMMOCKS	5	0	5	0	0
LEUCOBRYUM HUMMOCKS	0	0	0	0	0
TRICHOPHORUM TUSSECK	0	0	0	0	0
TRICHOPHORUM FLATS	0	0	0	0	< 5%
S. PAP HUMMOCKS	5	5	15	20	5%
S. PAP HOLLOWS	NA	5	NA	20	NA
S. MAG HUMMOCKS/LAWNS/HOLLOWS	15	20	< 5	0	10%
S. MAG HABITATS	lawns & hollows	lawns & hollows	hollows	hollows	lawns & hollows
S. CUSPIDATUM/E. ANG POOLS	15	0	< 5	20	15
R. FUSCA HOLLOWS	0	0	0	0	0
R. ALBA HOLLOWS	< 5	10	15	20	5
E. VAGINATUM HOLLOWS	15	20	5	0	25
NARTHECIUM	present	5	5	1	5
NARTHECIUM LAWNS	NA	0	NA	1	NA
S. MAG / S. CUSP POOLS	< 5	5	0	0	< 5%
S. SUBNITENS	0	0	0	0	0
S. AURIC POOLS	< 5	0	0	0	5
S. FUSCUM HUMMOCKS	0	0	0	0	0
S. CUSP	< 5	5	5	30	10
SPHAGNUM POOLS/LAWNS	20	5	30	40	25
SPHAGNUM HUMMOCKS	15	50	10	20	15%
SPHAGNUM HOLLOWS	NA	5	NA	5	NA
TOTAL SPHAGNUM COVER	40	60	40	60	40%
E. ANGUS	5	1	20	5	10%
QUALITY INDICATORS					

Clara Bog High Bog Ecological Survey

HUMMOCK INDICATORS	<i>S. imbricatum</i>		<i>S. imbricatum</i>		
POOLS INDICATORS	<i>S. cusp</i>	<i>S. cuspidatum</i>	<i>S. cusp</i>	<i>S. cuspidatum</i>	all
CLADONIA PORTENTOSA	< 5	0	5	1	5%
CLADONIA COVER	< 5	1	5	1	5%
TRICHOPHORUM TUSSECKS	0	0	0	0	0
NARTECIUM ABUNDANT	0	5	0	1	0
E. VAGINATUM TUSSECKS	NA	20	0	0	0
CAREX PANICEA	0	0	0	0	5%
S. MAGELLANICUM ABUNDANT	0	20	0	0	0
CLADONIA FLOERKEANA	0	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0	0
TEAR PATTERN	0	0	0	0	0
CALLUNA COVER	20	20	10	20	20
CALLUNA HEIGHT	0.3	0.2	0.3	0.3	0.4
OTHER DETAILS					
OTHER SPECIES		<i>S. magellanicum</i> , <i>S. papillosum</i> . Hollows <i>S. cuspidatum</i> . <i>E. angustifolium</i>		<i>D. anglica</i> , <i>E. tetralix</i>	<i>S. papillosum</i> in hollows and lawns
COMPLEX VARIATIONS					
SIMILAR DESCRIPTION					
OTHER DETAILS	<i>S. papillosum</i> in lawns	Poor SC pools	<i>S. papillosum</i> in hollows and lawns		Quadrat Qsc6 was not recorded in 2009. Quadrat Qf2 was recorded very close to former Qsc6 instead.

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SURVEY DATE	25/08/2009	25/08/2009	26/08/2009	31/08/2009	31/08/2009
COMPLEX_NA	6/10	7/9/10	7/9/10	10/6	10/9
GPS READING	224696,230394	223664,230745	223833,229909	225010,230321	225659,229431
ECOTOPE_TY	Sub-central	Sub-central	Sub-central	Sub-central	Sub-central
QUADRAT NAME	Qsc7	Qsc8	Qsc9	Qsc10	Qsc11
FIRMNESS	Very soft	Very soft	Very soft	Soft	Very soft
CRACKING	No	No	No	No	No
BOG BURST	No	No	No	No	No
SLOPE	Depression	Flat	Gentle slope	Gentle slope	Flat
DRAINS					
BURNT	Yes	No	No	No	No
TREND	Wetter	Stable	Wetter	Wetter	Unknown
ALGAL HOLLOWES	0	0	0	0	0
ALGAL POOL	0	0	0	0	0
BARE PEAT	0	0	0	0	5
POOLS COVER	5	0	5	0	15
POOLS TYPE	Regular Pools	Absent	Regular Pools	Absent	Regular Pools
MICRO TOPOGRAPHY	Low/hummocks/ hollows	Low/hummocks/ hollows	Low humm/ holl/pool	Low/hummocks /hollows	Low humm/ holl/pool
COMMUNITY					
S. CAP HUMMOCKS	20	40	50	10	10
S. IMBRIC HUMMOCKS	0	5	0	0	0
LEUCOBRYUM HUMMOCKS	0	0	0	0	0
TRICHOPHORUM TUSsock	10	0	1	5	0
TRICHOPHORUM FLATS	0	0	0	0	0
S. PAP HUMMOCKS	10	5	10	40	30
S. PAP HOLLOWES	10	5	10	40	0
S. MAG HUMMOCKS/LAWNS/HOLLOWES	60	0	5	30	0
S. MAG HABITATS	60	0	5	30	0
S. CUSPIDATUM/E. ANG POOLS	5	0	5	0	0
R. FUSCA HOLLOWES	0	0	0	0	0
R. ALBA HOLLOWES	10	10	5	10	5
E. VAGINATUM HOLLOWES	10	20	0	10	0
NARTHECIUM	10	5	0	5	5
NARTHECIUM LAWNS	10	0	1	0	0
S. MAG / S. CUSP POOLS	0	0	0	0	0
S. SUBNITENS	0	0	0	0	0
S. AURIC POOLS	0	0	0	0	0
S. FUSCUM HUMMOCKS	0	0	0	0	0
S. CUSP	5	5	5	5	5
SPHAGNUM POOLS/LAWNS	5	0	40	0	10
SPHAGNUM HUMMOCKS	60	50	30	20	30
SPHAGNUM HOLLOWES	10	10	10	10	10
TOTAL SPHAGNUM COVER	80	60	80	80	50
E. ANGUS	1	1	1	5	5
QUALITY INDICATORS					
HUMMOCK INDICATORS		<i>S imbricatum</i>			

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POOLS INDICATORS	<i>S. cuspidatum</i>	<i>S. cuspidatum</i>	<i>S. cuspidatum</i>	<i>S. cuspidatum</i>	<i>S. cuspidatum</i>
CLADONIA PORTENTOSA	0	5	1	1	5
CLADONIA COVER	0	5	1	0	0
TRICHOPHORUM TUSSOCKS	10	0	1	1	0
NARTHECIUM ABUNDANT	20	5	5	0	5
E. VAGINATUM TUSSOCKS	0	0	20	0	5
CAREX PANICEA	5	0	0	5	0
S. MAGELLANICUM ABUNDANT	60	0	5	30	0
CLADONIA FLOERKEANA	0	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0	0
TEAR PATTERN	0	0	0	0	0
CALLUNA COVER	30	0	20	10	20
CALLUNA HEIGHT	0.1	0	0.2	0.3	0
OTHER DETAILS					
OTHER SPECIES		<i>D. rotundifolia,</i> <i>D. anglica, A.</i> <i>polifolia</i>	<i>E. tetralix,</i>	<i>D. rotundifolia,</i> <i>Andromeda</i>	
COMPLEX VARIATIONS					
SIMILAR DESCRIPTION					
OTHER DETAILS	New quadrat. Recently burnt 2008	New quadrat	New quadrat. Drain blocked and infilling near	New quadrat. Lawns 50%	New quadrat

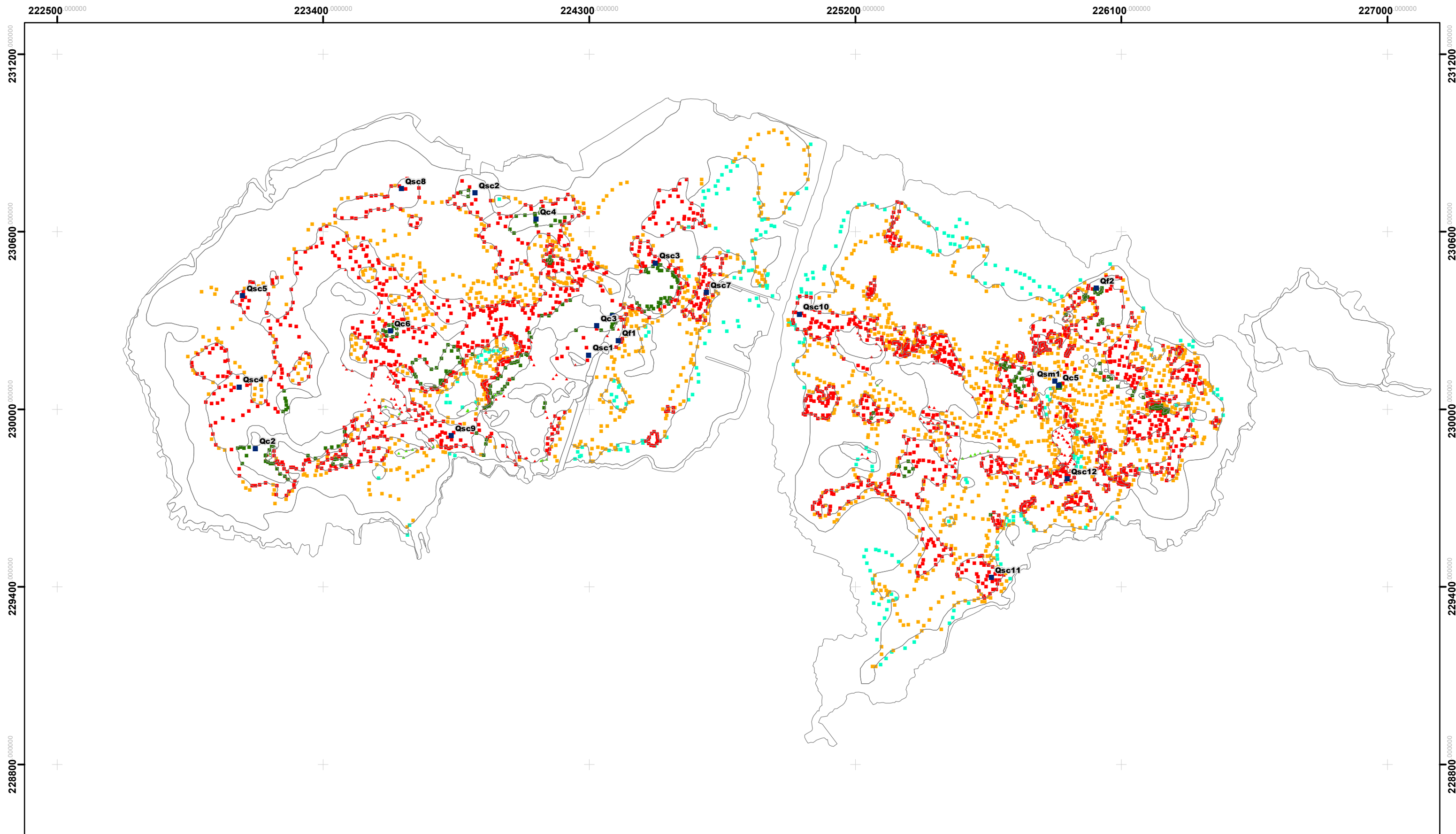
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SURVEY DATE	01/09/2009	24/08/2009	02/09/2009	01/09/2009
COMPLEX_NA	10/9	Active flush	Soak	9/7
GPS READING	225916,229764	224397,230231	226014,230408	225875,230094
ECOTOPE_TY	Sub-central	Active flush	Soak	Sub-marginal
QUADRAT NAME	Qsc12	Qf1	Qf2	Qsm1
FIRMNESS	Quaking	Soft	Quaking	Very soft
CRACKING	No	No	No	No
BOG BURST	No	No	No	No
SLOPE	Depression	Gentle slope	Depression	
DRAINS				
BURNT	No	No	No	No
TREND	Wetter	Unknown	Unknown	Unknown
ALGAL HOLLOWS	0	0	0	0
ALGAL POOL	0	0	0	0
BARE PEAT	0	0	0	0
POOLS COVER	20	0	90	
POOLS TYPE	Inter-connecting	Absent		Absent
MICRO TOPOGRAPHY	High Humm/holl/pool	High hummocks/hollow	Pools/lawns	High hummocks/hollow
COMMUNITY				
S. CAP HUMMOCKS	10	80	5	15
S. IMBRIC HUMMOCKS	0	0	0	0
LEUCOBRYUM HUMMOCKS	0	0	0	0
TRICHOPHORUM TUSsock	1	0	0	0
TRICHOPHORUM FLATS	0	0	0	0
S. PAP HUMMOCKS	40	0	10	10
S. PAP HOLLOWS	40	0	10	0
S. MAG HUMMOCKS/LAWNS/HOLLOWS	10	5	5	0
S. MAG HABITATS	10	0	5	0
S. CUSPIDATUM/E. ANG POOLS	10	0	90	0
R. FUSCA HOLLOWS	0	0	0	0
R. ALBA HOLLOWS	1	0	1	0
E. VAGINATUM HOLLOWS	20	0	1	0
NARTHECIUM	5	0	1	0
NARTHECIUM LAWNS	0	0	0	0
S. MAG / S. CUSP POOLS	0	0	0	0
S. SUBNITENS	0	5	0	0
S. AURIC POOLS	0	0	0	0
S. FUSCUM HUMMOCKS	0	0	0	0
S. CUSP	10	0	80	10
SPHAGNUM POOLS/LAWNS	20	0	100	10
SPHAGNUM HUMMOCKS	30	75	0	25
SPHAGNUM HOLLOWS	20	10	0	5
TOTAL SPHAGNUM COVER	70	85	100	40
E. ANGUS	5	0	5	2
QUALITY INDICATORS				
HUMMOCK INDICATORS				

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POOLS INDICATORS	<i>S. cuspidatum</i>		<i>S. cuspidatum</i>	<i>S. cuspidatum</i>
CLADONIA PORTENTOSA	1	0	0	20
CLADONIA COVER	1	0	0	0
TRICHOPHORUM TUSSECKS	1	0	0	0
NARTHECIUM ABUNDANT	5	0	0	0
E. VAGINATUM TUSSECKS	20	20	0	15
CAREX PANICEA	0	0	0	0
S. MAGELLANICUM ABUNDANT	10	5	5	0
CLADONIA FLOERKEANA	0	0	0	0
OTHERS % DISTURBANCE	0	0	0	0
TEAR PATTERN	0	0	0	0
CALLUNA COVER	20	40	0	25
CALLUNA HEIGHT	0.2	0.1	0	0
OTHER DETAILS				
OTHER SPECIES	<i>A. polifolia</i> , <i>D. rotundifolia</i> , <i>E. tetralix</i> .	<i>V. oxycoccus</i> , Birch saplings. 0.5-0.75m	Large <i>S. cuspidatum</i> , <i>E. angustifolium</i> , <i>M. trifoliata</i> pool. Recorded at the edge	
COMPLEX VARIATIONS				
SIMILAR DESCRIPTION				
OTHER DETAILS	New quadrat. Low hummocks, waterlogged	New quadrat	New quadrat. Near previously recorded Qsc6	New quadrat. Area of central was incorrectly mapped in this location in 2004.

Appendix IV Survey Maps



Clara Bog High Bog Ecological Survey (2009)

Map 2 - Vegetation complexes and quadrats

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Ecologic Environmental & Ecological Consultants Ltd.

Clara Bog SAC (000572) Co. Offaly

1:12,000

0 145 290 580 870 1,160 Meters



Vegetation complexes according to their corresponding ecotope

- | | | |
|---------------|------------------|----------------|
| ■ Central | ▲ Active flush | ■ Sub-marginal |
| ■ Sub-central | ▲ Inactive flush | ■ Marginal |