

RESTORING RAISED BOG IN IRELAND
Project Reference: LIFE04 NAT/IE/000121

A REPORT ON THE RESTORATION OF PROJECT SITE No. 3

CURRAGHLEHANAGH BOG, Co. GALWAY



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Project Site No. 3 - Curraghlehanagh Bog, Co. Galway

1. Introduction

Grid Reference IM6729 5498	Elevation (m) 80	Bedrock Geology Limestone
SAC Name and Number Curraghlehanagh Bog cSAC (2350) SAC Area (ha) 278	Project Site Area (ha) 40.7	Main Restoration Methods Clear-fell mature conifer crop Fell to waste young conifer crop Block drains with peat dams Control natural regeneration
Area of Conifer Cover (ha) 40.6	Area of Open Bog (ha) 0.1	Area of Birch Woodland (ha) 0
Noteworthy habitats/plant/animal species present Red Grouse a species that is becoming increasingly rare in Ireland, has been recorded on adjoining open bog		

General site description

Curraghlehanagh Bog is part of a bog cluster situated approximately 6km north of Mountbellew, Co. Galway. The site comprises a medium-sized raised bog with areas of high bog and cutover, which lies on a relatively low-lying plateau entirely within the upper reaches of the Shiven River (NPWS, 2002). The north-western margins of this bog have been afforested with conifers, much of which dates from the mid-1960's and this afforestation appears to occur on both on old cutover and along the margins of the high bog dome (Conaghan, 2003).

This is a typical example of Western Raised Bog habitat and the vegetation consists of Carnation Sedge (*Carex panicea*), with Bog Asphodel (*Narthecium ossifragum*) hollows and tussocks of Ling Heather (*Calluna vulgaris*), Hare's-tail Cottongrass (*Eriophorum vaginatum*) and Deer-grass (*Trichophorum caespitosum*). Other species present include the mosses *Campylopus atrovirens*, *Racomitrium lanuginosum* and the liverwort *Pleurozia purpurea*. Cranberry (*Vaccinium oxycoccos*) and Bog-rosemary (*Andromeda polifolia*) are locally abundant. The high bog supports an extensive quaking area with linear pools and lawns with Bog Moss (*Sphagnum cuspidatum*) and Bogbean (*Menyanthes trifoliata*). Lawns of bog mosses, including *Sphagnum magellanicum* and *S. auriculatum* occur between the pools. In general hummock cover is low, with occasional large *Racomitrium lanuginosum* tussocks. Purple Moor-grass (*Molinia caerulea*) and Common Reed (*Phragmites australis*) are found in association with flush areas to the west of the site along with scattered Downy Birch (*Betula pubescens*). Flora associated with the main channel in the bog burst to the east includes Ling Heather, Royal Fern (*Osmunda regalis*), Bog-myrtle (*Myrica gale*), Narrow Buckler-fern (*Dryopteris carthusiana*) and some orchid species. The epiphytic lichen flora is diverse with *Coelocaulon aculeatum* and *Usnea* spp. occurring on Ling Heather and *Cladonia cervicornis* subsp. *verticillata* on the bark of Birch trees (NPWS, 2002).

The small area of mixed woodland to the north-east supports Downy Birch, Rowan (*Sorbus aucuparia*), Oak (*Quercus* spp.) and Scot's Pine (*Pinus sylvestris*). In areas of abandoned cutover, Common Gorse (*Ulex europaeus*), Purple Moor-grass and Downy Birch are common, with bog moss regeneration being notably good in the south and north-eastern cutover (NPWS, 2002).

Current landuse on the site consists of peat-cutting along the northern and eastern margins. Afforestation has occurred on the high bog to the north-west of the site. These are all activities that have resulted in the loss of habitat and damage to the hydrological status of the site and pose a continuing threat to its viability. Damaging activities associated with these landuses include drainage and burning. Fire damage was recorded in the 1980's but the abundance of bog mosses indicates significant recovery of the bog surface (NPWS, 2002).

Project Site Description (Pre-restoration)

The project area contains of 40.6 hectares of conifer plantation, planted on high bog. These conifers consist largely of Lodgepole Pine (*Pinus contorta*). Although the conifers formed a closed canopy, some bog vegetation remained on the wet bog surface.

Description of bog vegetation adjoining planted areas

In general the bog vegetation which adjoins the planted areas is rather dry and disturbed, with wet pool areas absent. The vegetation is dominated by Ling Heather, Hare's-tail Cottongrass, Cross-leaved Heath (*Erica tetralix*), Deer-grass, the lichen *Cladonia portentosa* and the bog moss *Sphagnum capillifolium*. In places this bog has been affected by drains which run parallel to the plantation edge. These drains are approximately 4 metres apart and 1 metre deep. In the north of the site an area of cutover bog with frequent and tall Downy Birch occurs.

Restoration Actions

At this site the main restoration measures undertaken was the clear-felling and removal of the mature conifer crop, fell to waste of failed conifer crop, wind-rowing of the remaining brash and blocking of drains with peat dams. Although it may be difficult to re-wet areas of the site which have been dried-out severely by afforestation, e.g. along the track which runs along the north-western side of the site, there should be a good re-wetting effect in the northern end of the site where there are trees planted on deep peat of the high bog dome. Follow-up work included the control of the natural regeneration of conifer seedlings.

Blocking of drains may have a limited effect in areas of forestry which have been planted on cutover surfaces. These areas are very dry at present and have a shallow peat depth which will make obtaining material for the building of peat dams difficult. Regrowth of bog vegetation in areas of forestry planted on the high bog dome, should be more successful due to the greater depth of peat and the local presence of bog vegetation in areas of poor tree growth.

2. Methods

Prior to the start of restoration activities at the site, the habitats and vegetation occurring was surveyed and described (Conaghan, 2003). During the initial restoration work of 2005, permanent quadrats were established on each of the vegetation types within the project site.

During the field survey, particular attention was paid to the possible occurrence of plant and animal species which are considered to be rare in both a national and international context with particular emphasis on animal species listed in Annex II of the E.U. Habitats Directive and plant species listed in the Irish Red Data Book for vascular plants (Curtis and McGough, 1988), the 1999 Flora Protection Order and Annex II of the E.U. Habitats Directive.

3. Site Photographs

During the initial fieldwork a number of colour photographs of the site and vegetation encountered were taken and a selection of these are presented in this report. These include photographs taken by the Project Ecologist in order to illustrate the vegetation descriptions and changes in the habitats/vegetation present over time.

4. Vegetation of Project Site

The vegetation of the project site was previously dominated by either Sitka Spruce (*Picea sitchensis*) or Lodgepole Pine which is between 30 and 40 years old. Most of the Sitka Spruce has grown well and is of commercial quality. However there are some areas of tall but thin Lodgepole Pine which is non-commercial. These areas still support bog vegetation dominated by Ling Heather, Hare's-tail Cottongrass, Bilberry (*Vaccinium myrtillus*) and mosses such as *Sphagnum capillifolium*, *Hylocomium splendens* and *Pleurozium schreberi*. At the northern end of the site and a similar area which has been felled recently but not replanted. A small area of underdeveloped Sitka Spruce occurs along the margins of the high bog dome.

5. Changes in Overall Vegetation/Habitat Cover

Much of the site is now cleared of conifers and brash. The brash which remained after clear-felling was wind-rowed to allow bog vegetation to re-colonise exposed peat surface. Bog vegetation is starting to recolonise the high bog areas with the cutover bog supporting lagg zone vegetation.

6. Vegetation Monitoring Quadrats

The vegetation changes which have taken place within the site over the period of the restoration project are shown by means of observed changes in permanent quadrats. Five 10x10m permanent quadrats were installed on this site, which were described and photographed to monitor changes in vegetation over time. In order to ensure the future position of quadrats the corners have been marked with short stakes and an 8-figure GPS reading was also recorded. Vegetation tables of these quadrats are presented below.

Quadrat 1: This quadrat is located on the western margin of Curraghelanagh Bog and occurred under closed canopy conifer plantation on high bog with vegetation containing Purple Moor-grass, Soft Rush and some *Sphagnum* moss, but mainly dominated by brash.

With the clear-felling of conifers and blocking of drains, Soft Rush, Ling Heather and Hare's-tail Cottongrass became established. Over time, *Sphagnum* cover will increase and this wet bog margin will develop raised bog habitat. However the dominance of Soft Rush may need to be controlled.

Curraghelanagh Quadrat 1

Area: 10 x 10m **Location:** 5m South W2 **Grid Ref:** M6762 5434 **Altitude:** 78m
Bog Type: High Bog **Ecotope:** NA **Slope:** Flat **Aspect:** NA
Landuse: Forestry **Management:** Clearfell

Date	31/08/2005	29/08/2006	21/08/2007	06/08/2008
Firmness	Soft	Firm	Soft	V. Soft/Quaking
Drains	Yes	Yes	Yes/Blocked	Yes/Blocked
Canopy Cover %	0	0	0	0
Canopy Height	0	0	0	0
Vegetation Cover %	45	35	60	80
Vegetation Height (cm)	30	30	75	100
Dwarf Shrub Cover %	0	5	5	10
Herb Cover %	10	25	45	60
Bryophyte Cover %	35	35	35	40
Sphagnum cover %	25	20	20	15
Open Water %	0	5	10	5
Brash cover %	40	50	25	10
Pine Needle cover %	5	5	10	0
Pine Needle Depth cm	0	1	1	0
Bare Peat %	10	5	5	5
Species number	9	34	15	20
<i>Betula pubescens</i>	2	2	2	4
<i>Salix</i> spp.			1	2
<i>Rubus</i> spp.			5	3
<i>Potentilla erecta</i>			1	1
<i>Juncus</i> eff	5	15	15	20
<i>Juncus</i> sq.				10
<i>Molinia caerulea</i>	5	5	10	10
<i>Pteridium</i> spp.		1	1	2
<i>Epiolobium</i> spp.			2	3
<i>Vaccinium myrtillus</i>		1		2
<i>Calluna vulgaris</i>		5	5	5
<i>Erica tetralix</i>				3
<i>Eriophorium vaginatum</i>		1	5	10
<i>E. angustifolium</i>			2	5
<i>Campylopus atroverins</i>	3	2		5
<i>Hypnum jutlandicum</i>	5	8	5	10
<i>Polytricum commune</i>	2	3	10	10
<i>Sphagnum recurvum</i>				5
<i>S. capillifolium</i>	15	2	10	5
<i>S. subnitens</i>	5	3		
<i>S. magellanicum</i>	5	15	10	5

Curraghlanagh Quadrat 1, 2008



Quadrat 2: This quadrat is located on the north-western margin of Curraghlanagh Bog and occurred under closed canopy conifer plantation on cutover bog with vegetation containing *Hypnum* and *Sphagnum* moss, but is mainly dominated by brash and pine needles. With the felling of conifers and blocking of drains, Ling Heather has become established, but Soft Rush now dominates the vegetation. The dominance of Soft Rush indicates that peat depths are shallow at this location and that Lagg vegetation will become established here.

Curraghlanagh Quadrat 2

Area: 10 x 10m **Location:** 20m South W1 **Grid Ref:** M6773 5426 **Altitude:** 78m
Bog Type: Cutover Bog **Ecotope:** NA **Slope:** Flat **Aspect:** NA
Landuse: Forestry **Management:** Clear-fell

Date	31/08/2005	29/08/2006	21/08/2007	06/08/2008
Firmness	Dry	Firm	Soft	Soft
Drains	Yes	Yes	Yes/Blocked	Yes/Blocked
Canopy Cover %	0	0	0	0
Canopy Height	0	0	0	0
Vegetation Cover %	45	35	55	85
Vegetation Height (cm)	20	20	20	100
Dwarf Shrub Cover %	0	5	5	10
Herb Cover %	5	15	20	60
Bryophyte Cover %	40	35	45	45
Sphagnum cover %	10	5	1	5
Open Water %	0	5	20	3
Brash cover %	35	30	20	5
Pine Needle cover %	20	30	10	2
Pine Needle Depth cm	2	1	5	1
Bare Peat %	0	0	5	5
Species number	6	12	12	17
<i>Betula pubescens</i>		2	5	2
<i>Salix</i> spp.				2
<i>Sorbu aucuparias</i>				1
<i>Rubus</i> spp		1	2	2
<i>Seneco jacobea</i>			1	1
<i>Rumex acetosella</i>		2		1
<i>Potentilla erecta</i>				1
<i>Juncus</i> eff		4	10	40
<i>Juncus</i> sq.				5
<i>Molinia caerulea</i>		1		
<i>Holcus lanatus</i>			1	2
<i>Pteridium</i> spp	3	5	2	1
<i>Epiolobium</i> spp	2		1	2
<i>Calluna vulgaris</i>		5	5	10
<i>Campylopus atroverins</i>	5	15	15	15
<i>Hypnum jutlandicum</i>	20	10	20	10
<i>Polytricum commune</i>	5	5	10	15
<i>Sphagnum recurvum</i>	10			
<i>S. subnitens</i>		2		
<i>S. magellanicum</i>		3	1	5

Curraghlanagh Quadrat 2, 2008



Quadrat 3: This quadrat is located on the southern margin of Curraghelanagh Bog and occurred under closed canopy conifer plantation high bog with vegetation containing Purple Moor-grass, Bilberry and *Hypnum* moss. With the felling of conifers and blocking of drains, Ling Heather and Bilberry cover increased. Over time, *Sphagnum* cover will increase and this wet bog margin will develop into raised bog habitat.

Curraghelanagh Quadrat 3

Area: 10 x 10m **Location:** 50m North W6 **Grid Ref:** M6725 5432 **Altitude:** 79m
Bog Type: High Bog **Ecotope:** NA **Slope:** Flat **Aspect:** NA
Landuse: Forestry **Management:** Clear-fell

Date	31/08/2005	29/08/2006	21/08/2007	06/08/2008
Firmness	Firm	Firm	Firm	Soft
Drains	Yes	Yes	Yes	Yes
Canopy Cover %	0	0	0	0
Canopy Height	0	0	0	0
Vegetation Cover %	60	50	75	75
Vegetation Height (cm)	50	50	50	50
Dwarf Shrub Cover %	7	25	30	30
Herb Cover %	20	25	45	45
Bryophyte Cover %	33	40	60	55
Sphagnum cover %	15	15	25	15
Open Water %	1	0	0	3
Brash cover %	30	25	25	10
Pine Needle cover %	9	25	10	10
Pine Needle Depth cm	1	1	1	1
Bare Peat %	0	0	0	2
Species number	14	16	16	16
<i>Pinus contorta</i>		1		
<i>Picea sitchensis</i>		1		
<i>Betula pubescens</i>			1	
<i>Rubus spp</i>	2	5	5	5
<i>Molinia caerulea</i>	10	15	25	20
<i>Pteridium spp</i>	2	1		2
<i>Epiolobium spp</i>		2	5	3
<i>Vaccinium myrtillus</i>	5	15	15	15
<i>Calluna vulgaris</i>	1	5	10	10
<i>Erica tetralix</i>	1	5	5	5
<i>Eriophorium vaginatum</i>		1		5
<i>E. angustifolium</i>			5	5
<i>Andromeda polifolia</i>	1	1	5	2
<i>Cladonia portentosa</i>	5	15	20	20
<i>Campylopus atroverins</i>	3			
<i>Hypnum jutlandicum</i>	15	25	30	30
<i>Polytricum commune</i>			5	10
<i>Sphagnum recurvum</i>	1			
<i>S cuspidatum</i>	1		1	
<i>S. capillifolium</i>	10	5	10	5
<i>S. subnitens</i>	3	2	10	5
<i>S. magellanicum</i>		10	5	5

Curraghelanagh Quadrat 3, 2008



Quadrat 4: This quadrat is located on the southern margin of Curraghelanagh Bog and occurred on open high bog with vegetation containing Purple Moor-grass, Ling Heather, Cross-leaved Heath, and Hare's-tail Cottongrass with some *Sphagnum* moss. With the blocking of drains on adjacent plantations, *Sphagnum* cover may increase and over time, the raised bog habitat of this wet bog margin will be protected.

Curraghelanagh Quadrat 4

Area: 10 x 10m

Location: 25m West W5

Grid Ref: M6711 5410

Altitude: 78m

Bog Type: High Bog

Ecotope: Marginal

Slope: Slight

Aspect: South

Landuse: Unplanted

Management: Non-intervention

Date	31/08/2005	29/08/2006	21/08/2007	06/08/2008
Firmness	Firm	Soft	Firm	Firm
Drains	No	No	No	No
Canopy Cover %	0	0	0	0
Canopy Height	0	0	0	0
Vegetation Cover %	100	100	100	100
Vegetation Height (cm)	50	50	50	50
Dwarf Shrub Cover %	30	25	25	20
Herb Cover %	65	75	75	80
Bryophyte Cover %	35	25	25	25
Sphagnum cover %	30	20	20	20
Open Water %	0	0	0	0
Brash cover %	0	0	0	0
Pine Needle cover %	0	0	0	0
Pine Needle Depth cm	0	0	0	0
Bare Peat %	0	0	0	0
Species number	12	15	13	13
<i>Picea sitchensis</i>	1	1	1	1
<i>Potentilla erecta</i>	2	2		5
<i>Juncus eff</i>			4	
<i>Molinia caerulea</i>	65	65	65	70
<i>Vaccinium myrtillus</i>		1	5	2
<i>Calluna vulgaris</i>	20	20	15	15
<i>Erica tetralix</i>	10	4	5	3
<i>Trichophorum caespitosum</i>		3		
<i>Eriophorium vaginatum</i>	5	2	5	2
<i>Andromeda polifolia</i>	1	1	1	1
<i>Vaccinium oxycoccos</i>	2	1	1	1
<i>Cladonia portentosa</i>	5	5	5	5
<i>Hypnum jutlandicum</i>	5	3	8	5
<i>Polytricum commune</i>		2		
<i>S. capillifolium</i>	20	10	10	10
<i>S. subnitens</i>	10	10	10	10

Curraghlanagh Quadrat 4, 2008



Quadrat 5: This quadrat is located on the south-western margin of Curraghelanagh Bog and occurred under closed canopy plantation on high bog with vegetation containing *Hypnum* moss, but is mainly dominated by brash and pine needles. With the felling of conifers and blocking of drains, Ling Heather and *Sphagnum* cover increased and over time, this wet bog margin will develop raised bog habitat.

Curraghelanagh Quadrat 5

Area: 10 x 10m **Location:** 50m North W7 **Grid Ref:** M6720 5390 **Altitude:** 81m
Bog Type: Cutover Bog **Ecotope:** NA **Slope:** Slight **Aspect:** West
Landuse: Forestry **Management:** Clear-fell

Date	31/08/2005	29/08/2006	21/08/2007	06/08/2008
Firmness	Very Dry	Firm	Firm	Firm
Drains	Yes (Blocked)	Yes (Blocked)	Yes (Blocked)	Yes (Blocked)
Canopy Cover %	0	0	0	0
Canopy Height	0	0	0	0
Vegetation Cover %	20	40	40	65
Vegetation Height (cm)	10	10	20	50
Dwarf Shrub Cover %	0	5	10	30
Herb Cover %	1	10	25	25
Bryophyte Cover %	19	25	40	45
Sphagnum cover %	2	5	15	20
Open Water %	2	0	5	2
Brash cover %	30	50	50	20
Pine Needle cover %	45	10	10	10
Pine Needle Depth cm	2	1	1	1
Bare Peat %	3	0	0	3
Species number	4	10	18	19
<i>Picea sitchensis</i>				1
<i>Rubus spp</i>		3	3	2
<i>Senecio jacobea</i>		1	1	1
<i>Taraxicum spp</i>			1	
<i>Rumex acetosella</i>		1	1	2
<i>Potentilla erecta</i>			1	2
<i>Juncus eff</i>		3	10	3
<i>Molinia caerulea</i>			5	5
<i>Luzula</i>		2	2	1
<i>Pteridium spp</i>	1		1	3
<i>Epiobium spp</i>			5	5
<i>Vaccinium myrtillus</i>			1	5
<i>Calluna vulgaris</i>		5	10	25
<i>Drosera rotundifolia</i>			1	
<i>Campylopus atroverins</i>	1	5	20	10
<i>Hypnum cupressiforme</i>		15	15	
<i>Hypnum jutlandicum</i>	16			5
<i>Polytricum commune</i>		1	10	10
<i>Sphagnum recurvum</i>				4
<i>S cuspidatum</i>				1
<i>S. subnitens</i>			5	5
<i>S. magellanicum</i>	2	5	10	10

Curraghlanagh Quadrat 5, 2008



7. Changes in Water-levels

Prior to restoration, Walrags were installed in the conifer plantation to record any changes in water-levels, due to tree removal and drain blocking. Water-levels were found to be up to **50cm** below the surface. With the removal of conifers and drain-blocking, there was a rise in the water-table in the plantations on the high bog and the water-table remains close to the bog surface throughout most of the year.

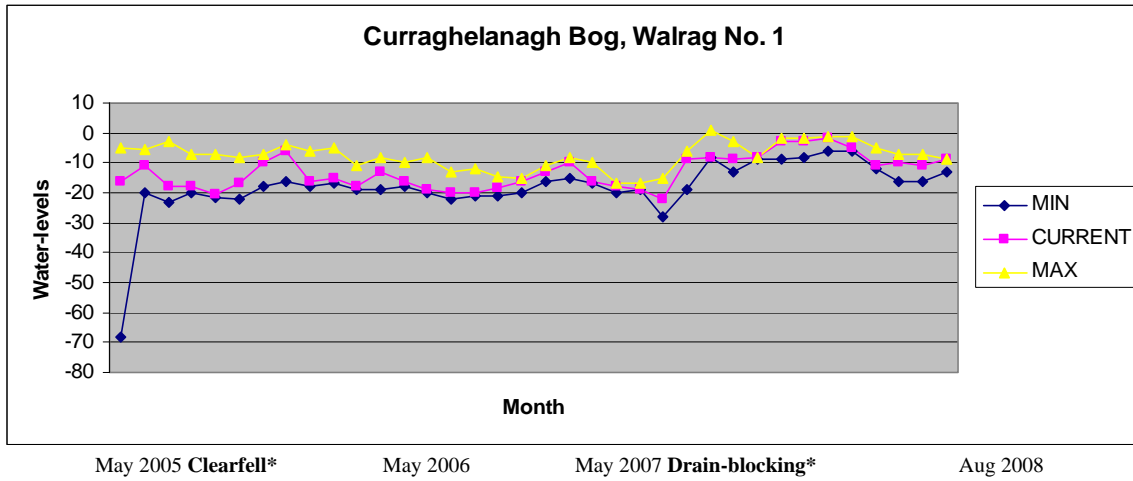


8. Hydrological Monitoring (Walrag) Graphs

During the clear-felling operation, eight Walrags were installed on this site to record the changes in water-levels. The rise in water-levels is clearly seen in the following graphs.

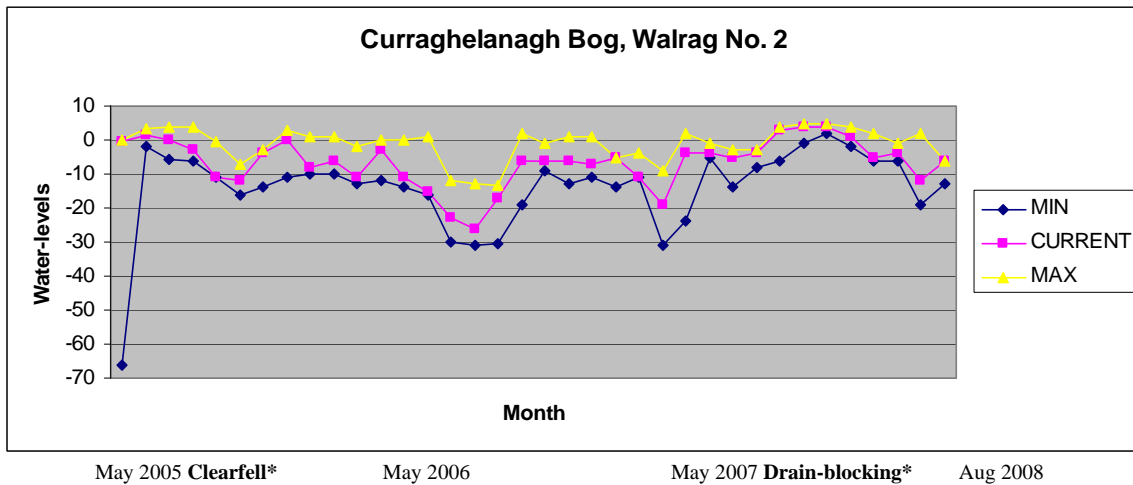
Curraghelanagh Bog Walrag 1: Clearfell on Cutover Bog

(Water-levels within 10 cm of bog surface post restoration*, lower in summer)



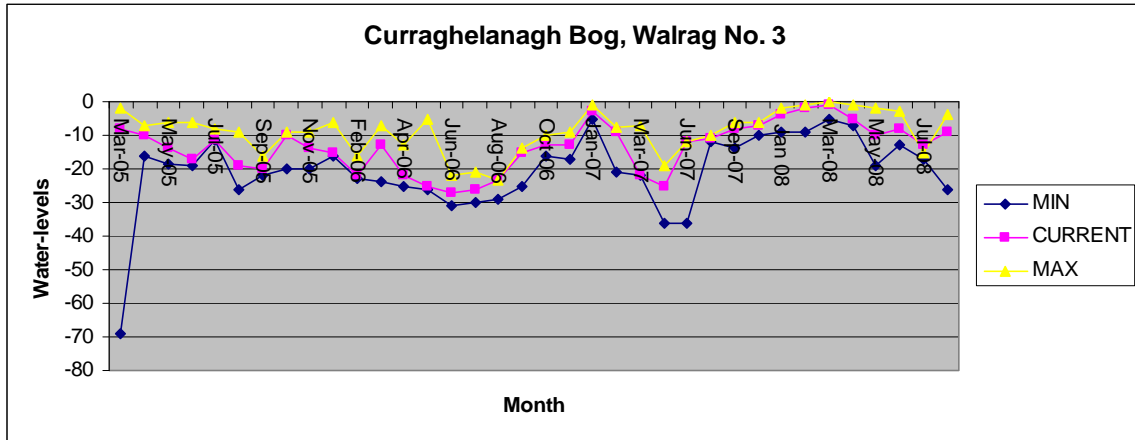
Curraghelanagh Bog Walrag 2: Clearfell on High Bog

(Water-levels within 10 cm of bog surface post restoration*, lower in summer)



Curraghelanagh Bog Walrag 3: Clearfell on High Bog.

(Water-levels within 10 cm of bog surface post restoration*, lower in summer)



May 2005 Clearfell*

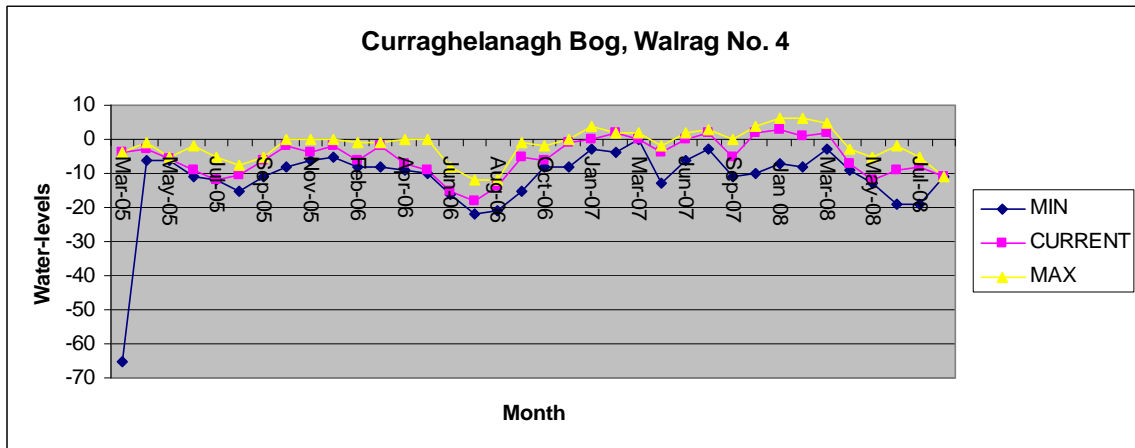
May 2006

May 2007 Drain-blocking*

Aug 2008

Curraghelanagh Bog Walrag 4: Fell to Waste on High Bog

(Water-levels within 10 cm of bog surface post restoration*, lower in summer)



May 2005 Clearfell*

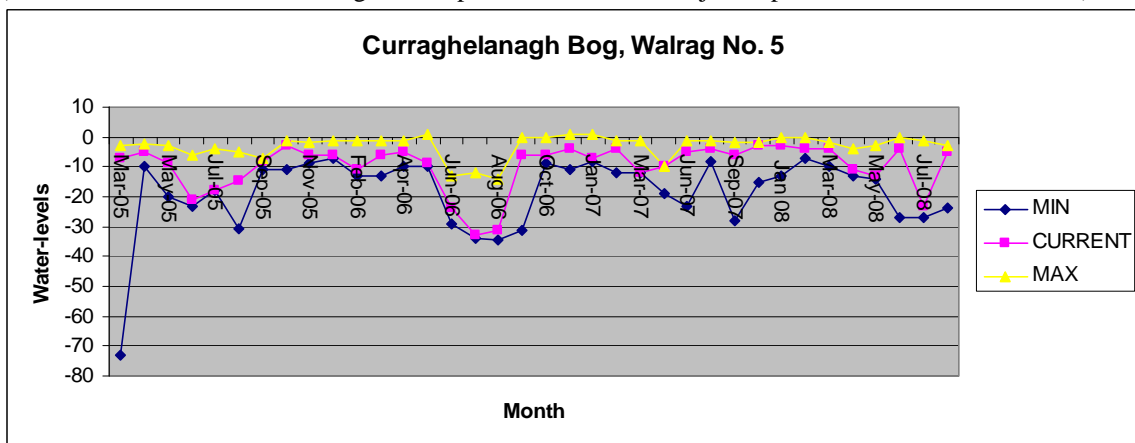
May 2006

May 2007 Drain-blocking*

Aug 2008

Curraghelanagh Bog Walrag 5: Open High Bog

(Water-levels within 10 cm of bog surface post restoration* on adjacent plantations, lower in summer)



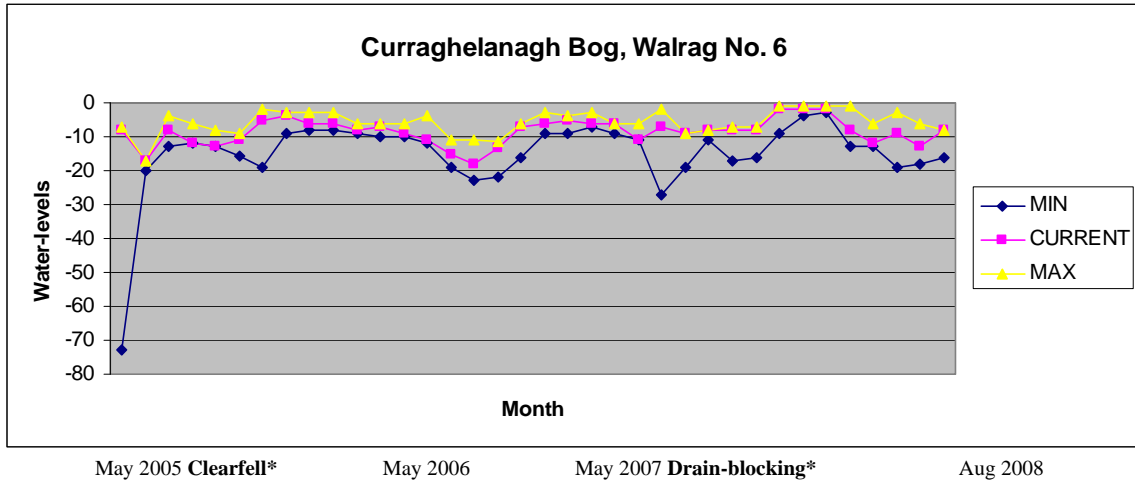
May 2005 Clearfell*

May 2006

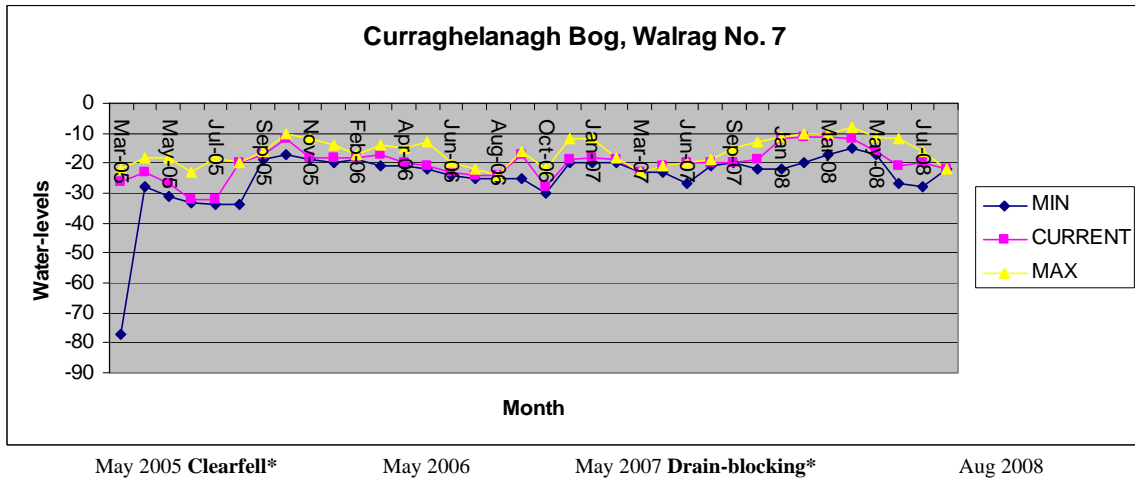
May 2007 Drain-blocking*

Aug 2008

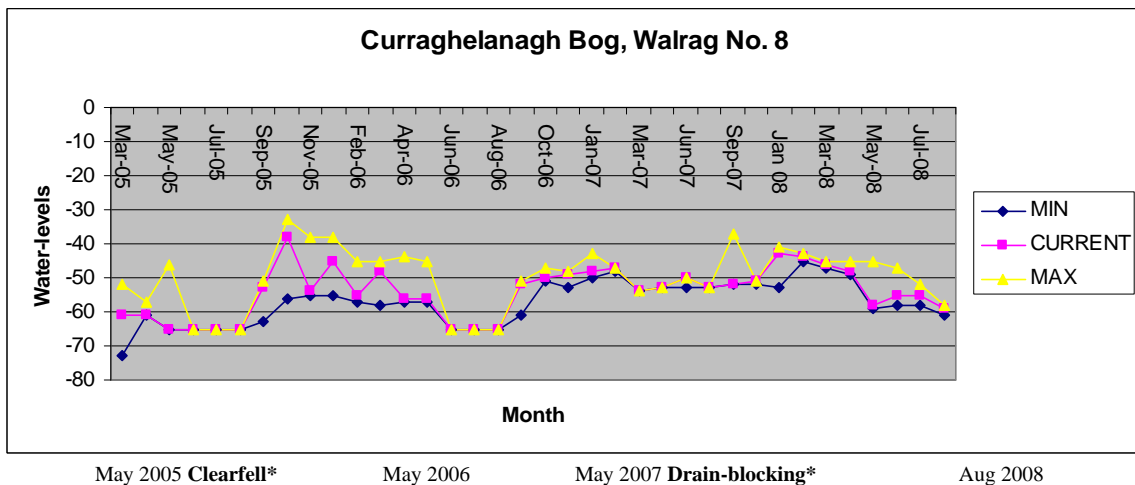
Curraghelanagh Bog Walrag 6: Fell to Waste on High Bog
 (Water-levels within 10 cm of bog surface post restoration*, lower in summer)



Curraghelanagh Bog Walrag 7: Clearfell on High Bog
 (Water-levels within 20 cm of bog surface post restoration*, lower in summer)



Curraghelanagh Bog Walrag 8: Clearfell on Cutover Bog
 (Water-levels 50 cm below bog surface post restoration*, due to shallow peat depth)



9. Conclusions

Water-levels have risen after clear-felling and blocking of drains and raised bog habitat is becoming established on the high bog areas. The cutover areas will revert to wet woodland as the peat is too thin to support raised bog habitat. Overall restoration measures will improve the conservation value of the entire site.

10. References

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