Bord na Móna

Enhanced Decommissioning, Restoration and Rehabilitation Scheme (EDRRS)

Annual Monitoring and Verification Report

EDRRS Year 1 Bogs

(Rehabilitation commenced in 2021)

Bord na Móna

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Note: Some text and figures in this report have been redacted to protect locations of some equipment and also some species.

List of Abbreviations

AA	Appropriate Assessment
ARA	Annual Relative Abundance
BOCCI	Birds of Conservation Concern in Ireland
BTO	British Trust for Ornithology
CBS	Countryside Bird Survey
CO_2	Carbon dioxide
CH_4	Methane
DECC	Department of Environment, Climate and Communications
DIC	Dissolved inorganic carbon
DOC	Dissolved organic carbon
EDRRS	Enhanced Restoration, Rehabilitation and Decommissioning Scheme
EPA	Environmental Protection Agency
ETB	Education and Training Board
GHG	Greenhouse gas
GIS	Geographic Information System
GPP	Gross primary production
GPR	Ground Penetrating Radar
IPC	Integrated Pollution Control
IWeBS	Irish Wetland Bird Survey
LAI	Leaf Area Index
LiDAR	Light Detection and Ranging
N_2O	Nitrous Oxide
NEE	Net Ecosystem Exchange
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
PAR	Photosynthetic Active Radiation
PCAS	Peatlands Climate Action Scheme
PPFD	Photosynthetic Photon Flux Density
POC	Particulate organic carbon

1. Introduction

This Annual Monitoring Report for the Enhanced, Decommissioning, Restoration and Rehabilitation Scheme (EDRRS) is prepared in accordance with Clause 11.6 of the EDRRS Regulatory Controls which states the following:

> *"Within six months of the end of each year that the Scheme is in operation, the Operator will submit an annual report on the Scheme to both DECC and NPWS/DHLGH. This report will include data on the Greenhouse Gas and biodiversity indicators agreed for the Scheme by all parties, on any future indicators agreed for the Scheme, the area restored under each Enhanced Rehabilitation Bog Plan, and the overall area restored in the year in question*."

In addition, Clause 9.2 of the EDRRS Funding Agreement states the following:

> *"An annual report prepared by BNM in respect of each calendar year in which the Agreement subsists shall be submitted to the Minister by 30th September of the following year ("the Annual Report"). The Annual Report shall detail the work done to further the aims and objectives and deliver the Scheme outcomes and outputs. For the avoidance of doubt the first calendar year end shall not be before the 31st December 2021."*

This report addresses the monitoring of the scheme and should be read in conjunction with the EDRRS Annual Report which details the Rehabilitation and Decommissioning carried out and other aspects of the scheme.

Funding for the Enhanced Monitoring, Restoration and Rehabilitation Scheme (EDRRS) was announced in November 2020 and rehabilitation commenced on eighteen bogs in 2021. An additional bog, Clooniff was approved for rehabilitation in 2021 however other than some mobilisation rehabilitation on this bog was postponed until 2022. Clooniff Bog is included in this report. For the purpose of the Annual reports, these nineteen bogs are referred to as the EDRRS Year 1 bogs and are listed in Table 1.1 below. A map of these bogs is also included in Appendix A of this report.

The Bord na Móna financial year runs from April to March and the first year of EDRRS is considered to run from April 2021 to March 2022. However, the additional months from the announcement of the scheme (November 2020) have also been included in the reporting period. While the end of the Bord na Móna financial year (referred to as FY22) was March 2022, for clarity, information on monitoring carried out in the EDRRS Year 1 bogs in the Summer of 2022 has also been included in this report. Therefore, this report addresses monitoring carried out from November 2020 to end June 2022 on the EDRRS Year 1 bogs listed in Table 1.1 below.

The Bord na Móna website and other documentation refers to this scheme as the Peatlands Climate Action Scheme (PCAS), however EDRRS will be used to describe this scheme throughout this document.

Table 1.1 EDRRS Year 1 Bogs

Bog Unit	County	Bord na Móna Works Area
Belmount	Offaly	Blackwater
Clooniff	Roscommon	
Garryduff	Galway	
Kellysgrove	Galway	
Kilmacshane	Galway	
Boora	Offaly	Boora
Derries	Offaly	
Oughter	Offaly	
Pollagh	Offaly	
Turraun	Offaly	
Castlegar	Galway	Derryfadda
Cavemount	Offaly	Derrgreenagh
Clonad	Offaly	
Esker	Offaly	
Mountlucas	Offaly	
Ummeras	Offaly and Kildare	
Derrycashel	Roscommon	Mountdillon
Derrycolumb	Longford	
Edera	Longford	

Rehabilitation commenced on an additional nineteen bogs in 2022 and these bogs are referred to as the EDRRS Year 2 bogs. A map showing the location of these bogs is included in Appendix A. This report will make some reference to baseline monitoring carried out on the EDRRS Year 2 bogs, however monitoring on these bogs will be addressed in next year's Annual Monitoring report.

1.1 Purpose of EDRRS Monitoring

The purpose of the monitoring on EDRRS is to quantify (where possible) the improvements in the bog following the implementation of the rehabilitation measures. This is done by developing a baseline, where possible, monitoring various parameters pertaining to hydrology, ecology and carbon emissions during the rehab implementation and post – rehabilitation. In some cases, observations during the initial bogs will inform the rehabilitation design for subsequent bogs.

It should be noted however that many of the parameters being monitored such as elements of biodiversity (notably habitats and/or vegetation succession) , along with carbon emissions will show little if any change over the lifetime of the scheme and further monitoring extending past the lifetime of EDRRS will be required to fully determine the trajectory of the bogs.

1.2 Description of the EDRRS Monitoring

There is a number of of monitoring workstreams carried out as part of EDRRS and these are summarised as follows:

A) Hydrological Monitoring
B) Biodiversity
C) Carbon Flux
D) Surface water Quality
E) Flow Monitoring
F) Archaeology
G) Aerial Imagery / Lidar

Details on the extent of the monitoring proposed for the scheme is set out below and the monitoring carried out on the EDRRS Year 1 bogs are set out on a bog by bog basis in Section 2 below.

1.2.1 Hydrological Monitoring

Hydrological monitoring is carried out within each of the proposed rehabilitation sites for the duration of the scheme. The key purpose of this monitoring is as follows:

1. Collect baseline data on the hydrological setting of each site to inform rehabilitation design (through characterisation of hydrological conditions as part of a conceptual model)
2. Collect data prior to, during and post-rehabilitation to determine the impact of specific rehabilitation measures in respect of elevating the water table to the optimal levels required
3. Collect data prior to, during and post-rehabilitation to inform future rehabilitation measure design in terms of prescription efficacy across differing environmental characteristics
4. Collect data prior to, during and post-rehabilitation which can be extrapolated across representative sections of the site to ensure that the site is on the correct anticipated trajectory.

The monitoring network is typically comprised of a phreatic (free water table) well and a deep piezometer installed within 50cm of the base of peat (Figure 1). The phreatic wells are 2.0m in length with a 1.5m screen, which is considered to be the maximum depth to water table that is likely to be encountered. Deep piezometers have a 50cm screen length. In cases where peat depth is <2m a phreatic well only will be installed as it is anticipated that there is potential for overlap in screened interval and there will be limited benefits to the monitoring programme. The purpose of the piezometer nest is to enable vertical hydraulic gradient to be estimated which will assist in understanding if there is a greater risk of increased rates of vertical infiltration through the peat to depth. Following piezometer nest installation each well is surveyed (top of casing, ground surface) using a survey-grade GPS. A nest of piezometers is comprised of one shallow and one deep piezometer.

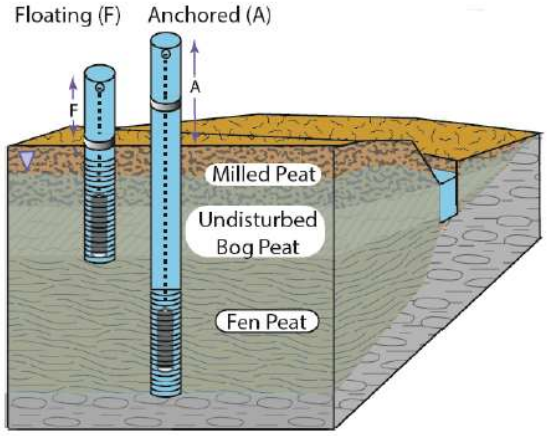

Figure 1.1: Typical monitoring nest configuration

The hydrological monitoring network is designed to consider a number of key factors including rehabilitation measures, peat depth and anticipated water levels post-rehabilitation, while also ensuring adequate spatial coverage across the site to assist in characterising the hydrological profile in transects across each bog. A number of practical considerations have also been included in the decision making process, including the ability to access and undertake routine monitoring into the future.

The approach is to undertake a combination of manual monitoring of water levels and use of automated loggers. A number of automated loggers (In Situ Rugged Troll 100) are available, and these are prioritised across each of the rehabilitation sites to areas considered most important for monitoring. The number of automated loggers per bog is summarised in the following table and set out in Section 2 below.

Table 1.2 Piezometer Locations in Year 1 Bogs

Bog Name	Deep Well (no logger)	Deep Well (with logger)	Shallow Well (no logger	Shallow Well (with logger)
Belmont	0	0	9	6
Boora	0	0	15	12
Castlegar	31	6	0	40
Cavemount	0	1	9	6
Clonad	0	0	14	11
Clooniff	3	0	16	10
Derries	0	0	10	7
Derrycashel	0	0	8	8
Derrycolumb	1	1	11	9
Edera	8	1	7	5
Esker	8	1	15	10
Garryduff	0	0	11	9
Kellysgrove	5	0	2	3
Kilmacshane	0	1	18	11
Mountlucas	0	1	13	16
Oughter	0	0	10	7
Pollagh	0	0	7	5
Turraun	0	0	7	6
Ummeras	4	1	8	5
Total	**60**	**13**	**190**	**186**

A dashboard is currently being developed that will facilitate viewing of the data collected on each piezometer. The hydrological monitoring data displayed for each bog in this dashboard has been measured at a relatively early stage in the monitoring program for post rehabilitation data. It is important to note that many of the bogs are not fully complete with key drainage features that existed pre-rehabilitation still remaining to enable the works. Once all the proposed measures are complete it is anticipated that there will be an impact on the ground water levels throughout the bog.

1.2.2 Biodiversity

Background information on biodiversity and summary metrics in respect of biodiversity-related monitoring under the current scheme has been set out previously in the EDRRS report titled '*Methodology Paper for the Enhanced Decommissioning, Rehabilitation and Restoration of Bord na Móna Peatlands'* available on the Bord na Móna scheme website[1]. The main objective of the EDRRS monitoring programme is to monitor and verify trajectories of change in response to the proposed re-wetting. As peat is re-wetted, some individual species can or may respond quickly to the new environment. The monitoring programme will ultimately demonstrate change in ecosystem functioning and the trajectory of the cutaway bog towards the development of a naturally functioning peatland ecosystem.

Biodiversity is treated as a core secondary area for monitoring and as such different monitoring methods/approaches have been included in the EDRRS monitoring programme. Further detail on the methods and frequency of surveys is included in the respective Monitoring and Verification Reports submitted to the scheme administrator, however a summary table in respect of the EDRRS YR1 Bogs is included overleaf as Table 1.3. The overall monitoring programme is stratified insofar as not every unique group (broad domain) was surveyed at every rehabilitation site. Different data (target domain outcomes) will also be collected at different scales over different timeframes (e.g. to monitor vegetation and habitat change, all scheme sites will have at minimum baseline habitat maps, and some have permanent vegetation quadrats that will be surveyed at the start and end of EDRRS, whilst others will have permanent vegetation quadrats that will be surveyed each year of the programme). Different locations (i.e. bogs subject to rehabilitation under the scheme) were selected to provide samples of the wide environmental variation of Bord na Móna peatlands (vegetated sites vs bare peat sites, different peat depths, different drainage regimes) and geographical variation across the Bord na Móna estate (east vs west for instance).

Methods and materials in respect of the various monitoring techniques are provided below. These cover the broad domains of habitats (habitat mapping and vegetation quadrats), birds (wintering and breeding) and invertebrates (pollinators). Citations are provided throughout as to the best practice methods which have been selected to measure the outcomes of rehabilitation and a list of full references is provided subsequently. A summary table of the scheme sites along with associated monitoring year and respective period covered in the present report is provided overleaf (Table 1-3).

[1] Supporting Material – Bord na Móna Peatlands Climate Action Scheme (bnmpcas.ie)

	Habitat Mapping Update	Bog Condition Mapping	Vegetation Quadrats	Breeding Birds	Winter Birds	Pollinators
Bog Name						
Belmont	2021 & 2025	2021 & 2025	2021 & 2024	2022 & 2025	2021 & 2023 &2025	2021 & 2023
Boora	2021 & 2025	2021 & 2025	N/A	2023 & 2025	2021 & 2024	N/A
Castlegar	2021 & 2025	2021 & 2025	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024
Cavemount	2021 & 2025	2021 & 2025	2021 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024
Clonad	2021 & 2025	2021 & 2025	2021 & 2024	2022 & 2025	N/A	2021 & 2022 & 2023 & 2024
Clooniff	2021 & 2025	2021 & 2025	N/A	2021 & 2024	2021 & 2022 & 2023 & 2024	N/A
Derries	2021 & 2025	2021 & 2025	N/A	N/A	N/A	N/A
Derrycashel	2021 & 2025	2021 & 2025	N/A	2022 & 2024 & 2025	2021 & 2025	N/A
Derrycolumb	2021 & 2025	2021 & 2025	2021 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024
Edera	2021 & 2025	2021 & 2025	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024
Esker	2021 & 2025	2021 & 2025	N/A	N/A	N/A	N/A
Garryduff	2021 & 2025	2021 & 2025	2021 & 2024	2022 & 2025	2021 & 2024	N/A
Kellysgrove	2021 & 2025	2021 & 2025	2021 & 2024	2021 & 2022 & 2023 & 2024	N/A	N/A
Kilmacshane	2021 & 2025	2021 & 2025	N/A	2022 & 2025	2021 & 2023 &2025	N/A
Mountlucas	2021 & 2025	2021 & 2025	N/A	2022 & 2025	N/A	N/A
Oughter	2021 & 2025	2021 & 2025	2021 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024
Pollagh	2021 & 2025	2021 & 2025	2021 & 2024	2021 & 2024	2021 & 2024	N/A
Turraun	2021 & 2025	2021 & 2025	N/A	2022 & 2025	2021 & 2024	N/A
Ummeras	2021 & 2025	2021 & 2025	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024	2021 & 2022 & 2023 & 2024

Table 1-3 Required Biodiversity Monitoring Surveys (Enhanced Rehabilitation) in respect of EDRRS Year 1 Bogs

Table 1-4 EDRRS Monitoring results included in the current report

Scheme Bog Name	Habitats		Birds		Invertebrates
	Habitat Mapping	**Vegetation Monitoring**	**Wintering**	**Breeding**	**Pollinators**
Belmont	YR1: 2021	YR1:2021	YR1:2021/22	YR1:2022	N/A
Clooniff	YR1: 2022	N/A	YR1:2021/22	YR1:2022	YR1:2022
Garryduff	YR1: 2022	YR1: 2021	YR1:2021/22	YR1:2022	N/A
Kellysgrove	YR1: 2021	YR1: 2021	N/A	YR1:2022	N/A
Kilmacshane	YR1: 2022	N/A	YR1:2021/22	YR1:2022	N/A
Boora	YR1: 2021&2022	N/A	YR1:2021/22	YR1:2022	N/A
Derries	YR1: 2022	N/A	N/A	N/A	N/A
Oughter	YR1: 2021	YR1: 2021	YR1:2021/22	YR1:2021 YR2:2022	YR1:2021 YR2:2022
Pollagh	YR1: 2021&2022	YR1: 2021	YR1:2021/22	YR1:2022	N/A
Turraun	YR1: 2022	N/A	YR1:2021/22	YR1:2022	N/A
Castlegar	YR1: 2022	YR1: 2022	YR1:2021/22	YR1:2022	YR1:2022
Cavemount	YR1: 2021	YR1: 2021	YR1:2021/22	YR1:2022	YR1:2021 YR2:2022
Clonad	YR1: 2021&2022	YR1: 2021	N/A	YR1:2022	YR1:2021 YR2:2022
Esker	YR1: 2021&2022	N/A	N/A	N/A	N/A
Mountlucas	YR1: 2021&2022	N/A	N/A	YR1:2022	N/A
Ummeras	YR1: 2021&2022	YR1: 2021	YR1:2021/22	YR1:2022	YR1:2022
Derrycashel	YR1: 2022	N/A	YR1:2021/22	YR1:2022	N/A
Derrycolumb	YR1: 2021&2022	YR1: 2021	YR1:2021/22	YR1:2021 YR2:2022	YR1:2021 YR2:2022
Edera	YR1: 2021&2022	YR1: 2021	YR1:2021/22	YR1:2022	YR1:2022

Methods

Monitoring methods per target domain and where relevant the associated Best Practice Guidelines are presented below in respect of Habitats, Vegetation Community Monitoring via quadrats, Wintering and Breeding Bird assemblage monitoring and Pollinator diversity monitoring.

Habitats

The approach to planning and management of habitat surveys followed best-practise guidance in the Irish context from Smith *et al.* 2011. Map outputs including all habitat maps and target notes were produced using GIS software application packages (ArcGIS) and a handheld tablet. Habitat mapping consisted of ground truthing previous habitat maps and adding data in the form of point data to

represent the habitats encountered. Habitat types were classified and digitised according to the Bord na Móna habitat classification system (see Table 1-5). General marginal habitats and other habitats that had not been modified significantly by industrial peat extraction were classified using Fossitt *et al.* (2000) (hereafter Fossitt). Plant nomenclature where referenced for vascular plants follows Stace (2019), while mosses and liverworts nomenclature, again where referenced, follows identification keys published by the British Bryological Society (2010). A more detailed Bord na Móna classification system has previously been developed for classifying pioneer cutaway habitats, as Fossitt categories were deemed not to be detailed enough for cutaway bog (much of cutaway bog could be classified as Cutover Bog - PB4). See individual bog accounts for further information.

Note 1: Habitat Maps are still being produced in respect of YR1 (Year 1) habitat surveys, following discussion with NPWS (National Parks and Wildlife Service) and recent scheme workshops around habitat classification. These maps will be provided in due course once available.

Note 2: Regarding Quadrat data presented in the standalone bog appendices, we note that abbreviated scientific names are utilised within the tables presented for plant species. This follows the established drop down menu utilised in field data collection via a tablet. Full scientific names of any species referenced are utilised in the main text where relevant.

Vegetation Quadrats

Vegetation monitoring quadrat locations were aligned with piezometer monitoring locations as previously set out in agreed EDRRS Monitoring and Verification. Each quadrat was visited by a single ecologist and data plus target notes were produced using GIS software application packages (ArcGIS) and a handheld tablet. Variables recorded included surveyor name and data, Bord na Móna classification code, a cutover habitat description code, and then percentage cover respectively of *Sphagnum* species, bare peat, and open water. If vegetation was present, then vegetation height and a full list of species was recorded. See individual bog accounts for clarification on number of quadrats surveyed along with representative sample photographs.

Table 1-51 Bord na Móna habitat classification system

Habitat Category	Habitat	BnM habitat code	BnM map category	nearest Phytosociological syntaxa	Fossitt (2000) classification	Fossitt Code
Peatland	Bare peat (0-50% cover)	BP	Bare peat		Spoil and bare ground	ED2
Peatland	pioneer *Eriophorum angustifolium* community (acidic)	PBa	Embryonic bog	Oxycocco-Sphagnetea	Bog	PB
	Sphagnum cuspidatum-Eriophorum angustifolium community	PBb	Embryonic bog	Oxycocco-Sphagnetea	Bog	PB
	Embryonic bog community (somewhat more diverse and developed)	PBc	Embryonic bog	Calluno-Sphagnion	Bog	PB
Fen	Pioneer *Campylopus* dominated community	pCamp	Pioneer Poor fen	Caricion curto-nigrae	Poor fen	PF2
	Pioneer *Juncus effusus* community	pJeff	Pioneer Poor fen	Caricion curto-nigrae	Poor fen	PF2
	Pioneer *Eriophorum angustifolium* community (poor fen)	pEang	Pioneer Poor fen	Caricion curto-nigrae	Poor fen	PF2
	Pioneer *Juncus bulbosus* community	pJbulb	Pioneer Poor fen	Caricion curto-nigrae	Poor fen	PF2
	Pioneer *Triglochin palustris* community	pTrig	Pioneer Poor fen	Caricion curto-nigrae	Poor fen	PF2
	Pioneer *Juncus* with *Sphagnum*	pJunc	Pioneer Poor fen	Sphagneto-Juncetum	Poor fen	PF2
	Pioneer rich fen community with *Schoenus nigricans* (rudimentary rich fen)	Pschon	Rudimentary Rich fen		Rich fen	PF1
	Pioneer Carex viridula/brown moss community (rich fen)	pVir	Rudimentary Rich fen		Rich fen	
	Pioneer *Cladium* community	pCladium	Rudimentary Rich fen	Caricion davallianae	Rich fen	PF1
Emergent communities	*Carex rostrata* community	pRos	Pioneer Poor fen	Cariculion rostratae	Reed and large sedge swamps	FS1
	Carex paniculata community	pPan	Pioneer Poor fen	Caricetum paniculatae	Reed and large sedge swamps	FS1
	Phragmites australis community	pPhrag	Reedbeds	Scirpo-Phragmitetum	Reed and large sedge swamps	FS1
	Typha community	pTyp	Reedbeds	Typhetum latifoliae	Reed and large sedge swamps	FS1
	Schoenoplectus community	pSch	Reedbeds	Scirpo-Phragmitetum	Reed and large sedge swamps	FS1
Open water/aquatic	Permanent pools and lakes	OW	Open water	Isoeto-Litorelletea	Dystrophic lakes	FL1
	Permanent pools and lakes	OW	Open water	Isoeto-Litorelletea	Acid-oligotrophic lakes	FL2
	Charophytes	pChar	Aquatic communities	Charetea	Limestone/Marl lakes	FL3
	Temporary open water	tOW	Temporary open water			
Woodland and scrub	Emergent *Betula*-dominated community (A)	eBir	Birch scrub	Salici-Betuletum pubescentis	Scrub	WS1
	Open *Betula*-dominated community (B)	oBir	Birch scrub	Salici-Betuletum pubescentis	Scrub	WS1
	Closed *Betula* scrub community (C)	cBir	Birch scrub	Salici-Betuletum pubescentis	Scrub	WS1
	Ulex-dominated community	eGor	Gorse scrub		Scrub	WS1
	Betula-Salix woodland	BirWD	Birch - Willow woodland	Salici-Betuletum pubescentis	Bog woodland	WN7
Heathland	Dry *Calluna* community	dHeath	Dry Heath	Calluno-Ulicetalia	Dry heath	HH1
	Wet Heath community	wHeath	Wet Heath	Narthecio-Ericetum	Wet Heath	HH3
	Dense *Pteridium*	dPter	Bracken	Rhamno-Prunetea	Dense Bracken	HD1
Grassland	Dry calcareous grassland	gCal	Dry grassland	Centaureo-Cynosuretum	Dry calcareous and neutral grassland	GS1
	Anthoxanthum -Holcus-Equisetum community	gAn-H-Eq	Dry grassland	No close affinities to Irish syntaxa	Dry calcareous and neutral grassland	GS
	Dactylis-Arrhenatherum community	gDact-Arr	Dry grassland	Arrhenatheritum elatioris	Dry meadows and grassy verges	GS2
	Molinia caerulea-dominated community	gMol	Acidic grassland	Junco conglomerati-Molinion	Wet grassland	GS4
	Marsh - *Filipendula* and other tall herbs	Mar	Marsh	Filipendulion ulmariae	Marsh	GM1
Ruderal	*Tussiligo*-dominated community (vegetation > 50%)	DisCF	Disturbed & pioneer vegetation	Tussilaginetum	Recolonising bare ground	ED3
	Epilobium-dominated community (vegetation > 50%)	DisWil	Disturbed & pioneer vegetation	Tussilaginetum	Recolonising bare ground	ED3
General	Riparian areas (stream or drain with associated edge habitats, FW2/4)	Rip			Lowland River/Drainage Ditches	FW2/FW4
	Access (tracks or railways with associated edge habitats, BL3)	Acc			Buildings and artificial surfaces	BL3

Wintering Birds

Fixed counts, following I-WeBS (Irish Wetland Bird Survey) methods, were used to count wintering waterfowl. Counts were targeted at the period September to March inclusive. I-WeBS uses the well-established technique of counting the numbers of water birds at wetland sites by the 'look-see' method (Bibby *et al.* 1992). This involves counters recording the number of individuals of each water bird species on survey visits to pre-defined wetland sites. The main objective was to establish a baseline for monitoring at a single site which has been subject to rehabilitation. See individual bog accounts for clarification on number of visits undertaken.

Note: For the purposes of the current report we define wintering water bird species richness on the following scale; 'High'=16-20 species, 'Medium'=11-15 species, 'Low'=6-10 species and 'Very low' = 0-5 species. Non water bird species are excluded. Site importance where discussed is is aligned with thresholds as set in the Irish context for the wildfowl monitoring scheme the Irish Wetland Bird Survey (IWeBS).

Breeding Birds

Breeding bird surveys utilised a transect method generally following the existing Countryside Bird Survey (CBS) (Lewis *et al.* 2019). Each transect was placed along an existing high field, 'headland' or rail line corridor for ease of use but also because these locations will continue to be accessible post rehabilitation, allowing the same route to be repeated. Either two visits, comprising an early and late season visit in the period April to June, or four visits in the period April to July were carried out on a per bog basis. Each transect was walked by a single observer equipped with binoculars and bird species were recorded in line with CBS Guidelines (e.g. no juvenile birds were recorded, any colonies were recorded separately etc.). See individual bog accounts for clarification on number of visits undertaken.

Where a bespoke breeding wader survey was also scoped for Monitoring and Verification, this was carried out in line with O'Brien & Smith (1992) and comprised walking a predefined route or transect across the bog on each of 4 visits in the period April to July inclusive. The route aligned with the CBS transects for ease of implementation. Per visit the total number of adult wading birds observed from the transect, wading young observed and the estimated total number of pairs were recorded by a single observer equipped with binoculars. See individual bog accounts for clarification on required survey scope and number of visits undertaken along with any constraints on a per bog basis.

Note: Bird nomenclature follows the names most broadly used in Ireland[2][3], but with occasional modification. For readability we have not always used the 'Common' preface before some species (e.g. Snipe) but in instances where paired species occurred (Snipe and Jack Snipe) we have expanded names used to 'Common' Snipe and Jack Snipe, but then revert to the shorter name. In some instances the IOC World List name (Gill *et al.* 2022) may be used e.g. Great Egret rather than Great White Egret where the IOC name is now commonly used. In each table of bird data species common names are prefaced with the British Trust for Ornithology (BTO) single or two letter code [4] and followed with the scientific name. All references to Redpoll infer 'Lesser' Redpoll *Acanthis cabaret*.

[2] List-of-Irish-Birds-v12.0(JH).pdf (southdublinbirds.com)

[3] checklist-Ireland 14.5.1 with IOC9.1 Rev-nossp 2018IRBR-2 by S Enright (irbc.ie)

[4] species_codes.pdf (bto.org)

Pollinators

A transect (of varying length) was established across part of the relevant bog to record pollinators, indicator species (Butterflies) and other taxa. Pollinator recording followed guidelines set out by the National Biodiversity Datacentre Bumblebee Monitoring Scheme. Where possible the same transect route was walked per visit (any amendments to transect routes, such as between years, are described under individual bog accounts) and species recorded per 100m section (n=20 in total) within 2.5 m either side of and 5 m in front (a 5 m^3 recording 'box') of the observer. Each visit was undertaken by a single observer. Counts were targeted to be completed between 11:00 and 17:00hrs, when the temperature was at least 13°C and during good weather conditions. See individual bog accounts for clarification on number of visits undertaken and any constraints.

Findings Summaries

Relevant findings summaries are presented below to assist in general reading of this document. We refer to individual bog accounts for more detailed information and discussion. Vegetation quadrat data is excluded. See also summary metrics in respect of biodiversity-related monitoring under the current scheme as set out previously in the EDRRS report titled '*Methodology Paper for the Enhanced Decommissioning, Rehabilitation and Restoration of Bord na Móna Peatlands*'

Habitats

The general objective of habitat mapping is to '*Measure longer-term **broad scale** changes in vegetation following rehabilitation under the scheme'* as outlined in other reporting such as the published EDRRS methodology paper.

The Habitats findings summary table, overleaf, summarises findings for the current reporting period and associated bogs. Regarding trajectory, evaluations apply to measurable evidence of changes to constitutent habitat characteristics, attributable to rehabilitation.

Table 1-6 Habitat Findings Summary. Comments generally reflect changes since rehab was carried out. Green in the re-wetting column indicates positive re-wetting across the site. Green in the Trajectory column indicates positive habitat changes or vegetation establishment since rehab was carried out. Yellow in the trajectory column indicates no measurable evidence of changes in vegetation following rehabilitation, in the current reporting period.

Bog Name	Monitoring	Expected Future Habitats	Re-wetting Progress	Trajectory	Observations
Belmont	2021/2022	1. Wetland habitats on shallow peat - rich fen, poor fen, Reed and large sedge swamp, wet woodland. 2. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 3. Dry cutaway habitats on shallow peat - Birch Woodland, dry grassland and dry heather dominated vegetation. 4. Bog remnants – Raised bog			5. Conditions across site significantly changed – re-wetted. 6. One third of Belmont remains as bare peat. 7. Some fresh pioneering vegetation present 8. New vegetation cover is very low. 9. Alkaline indicator species of rudimentary rich fen occur scattered throughout the bog. 10. Re-wetting has consolidated suitable conditions for expected fen habitat trajectory.
Clooniff	2022	1. Wetland habitats on shallow peat – open water, fen, Reedswamp and wet woodland. 2. Dry cutaway habitats on shallow peat – Birch woodland. 3. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 4. Bog remnant – Raised bog			5. Conditions across site significantly changed – re-wetted. 6. New pioneer wetlands have been noted. 7. Water levels in existing wetland stabilised over summer. 8. New vegetation cover is very low. 9. No changes in existing vegetation/habitats yet. 10. Re-wetting has consolidated suitable conditions for expected habitat trajectory. 11.
Garryduff	2022	1. Wetland habitats on shallow peat – open water, fen, Reedswamp and wet woodland. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland and dry heather dominated vegetation. 3. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 4. Bog remnant – Raised bog			5. Conditions across site changed somewhat – site was already re-wetting. Some measures to implement. 6. Some new wetlands with shallow surface water noted. 7. One third of Garryduff remains as bare peat or open water on bare peat, 8. Very little new pioneering vegetation. 9. Alkaline indicator species of rudimentary rich fen present. 10. Re-wetting has consolidated suitable conditions for expected wetland and fen development.
Kellysgrove	2021	1. Raised bog (PB1) - improving in condition, with an increase Annex I active raised bog			2. Drain blocking has been very effective – high water levels noted in blocked drains. 3. No changes in established vegetation noted yet. 4. The bog is significantly wetter, indicates good future prospects for raised bog restoration.
Kilmacshane	2022	1. Wetland habitats on shallow peat – open water, fen, Reedswamp and wet woodland.			5. Conditions across site changed somewhat – site was already re-wetting.

Bog Name	Monitoring	Expected Future Habitats	Re-wetting Progress	Trajectory	Observations
		2. Deep peat habitats - mosaic of embryonic raised bog and Sphagnum-rich poor fen 3. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland and dry heather dominated vegetation. 4. Bog remnant – Raised bog			6. Very little new pioneering vegetation is present in bare peat areas within the rehab footprint. 7. No changes in existing vegetation/habitats noted yet. 8. Re-wetting has consolidated suitable conditions for expected wetland and fen development.
Boora	2021/2022	1. Wetland habitats on shallow peat – open water, fen, Reedswamp and wet woodland. Some potential for rich fen development. 2. Deep peat habitats - mosaic of embryonic raised bog and Sphagnum-rich poor fen 3. Dry cutaway habitats on shallow peat – Birch Woodland, Oak-Ash-Hazel (WN2), dry grassland and dry heather dominated vegetation.			4. Conditions across targeted area significantly changed – re-wetted. 5. No changes in established vegetation noted yet. 6. Boora West is one site where there has been rapid change since 2019 when peat extraction ceased from mostly bare peat to mostly pioneer vegetation cover. 7. Re-wetting has created suitable conditions for expected habitat development.
Derries	2022	1. Wetland habitats on shallow peat – open water, fen, Reedswamp and wet woodland. 2. Deep peat habitats - mosaic of embryonic raised bog and Sphagnum-rich poor fen. 3. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland and dry heather dominated vegetation. Oak-Ash-Hazel (WN2).			4. Conditions across site changed somewhat. Targeted measures implemented. Re-wetted in part. 5. Habitats already established. 6. No changes in established vegetation noted yet. 7. More time needed to evaluate planned re-wetting at this site.
Oughter	2021	1. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. Some rich fen (alkaline fen and Cladium fen) likely to eventually develop. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland and dry heather dominated vegetation.			3. Conditions across site significantly changed – re-wetted. 4. No indications of recent changes to more established habitats in response to rehabilitation measures yet. 5. Very little new pioneering vegetation yet. 6. Re-wetting has consolidated suitable conditions for expected fen and wetland habitat development.
Pollagh	2021/2022	1. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. Some rich fen (alkaline fen and Cladium fen) likely to eventually develop. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland and dry heather dominated vegetation. 3. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen			4. Conditions across site radically changed – site re-wetted. 5. No indications of recent changes to more established vegetation/habitats in response to rehabilitation measures yet 6. Almost no new pioneering vegetation is present within the bare peat areas in the rehabilitation extent. 7. Re-wetting has created suitable conditions for expected mosaic of wet cutaway habitat development.
Turraun	2022	1. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. Some rich fen			3. Conditions across site changed somewhat. Site re-wetted in part. Targeted measures implemented. Some still left to do.

Bog Name	Monitoring	Expected Future Habitats	Re-wetting Progress	Trajectory	Observations
		(alkaline fen and Cladium fen) likely to eventually develop. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland and dry heather dominated vegetation. Oak-Ash-Hazel (WN2) woodland.			4. Some new wetlands with shallow surface water noted. 5. No indications of recent changes to more established habitats in response to rehabilitation measures yet 6. No recordable change of vegetation cover noted yet. 7. More time needed to evaluate planned re-wetting across this site.
Castlegar	2022	1. Deep peat habitats (mosaic of Embryonic raised bog and Sphagnum-rich poor fen). Where hydrological conditions are not optimal for the development of an embryonic *Sphagnum*-rich vegetation, Birch woodland, dry heather dominated vegetation and other drier habitats will be more prevalent.			2. Conditions across site radically changed – site re-wetted. 3. No recordable change of vegetation cover noted yet. 4. Some drains that have been partially blocked are already beginning to colonise with *Sphagnum cuspidatum* that was already present on site. 5. Re-wetting has created suitable conditions for expected habitat development.
Cavemount	2022	1. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. Some rich fen (alkaline fen and Cladium fen) likely to eventually develop. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and dry heather dominated vegetation. 3. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. Small proportion of Birch Woodland.			4. Conditions across site changed somewhat – site re-wetted. 5. No indications of recent changes to more established habitats in response to EDRRS measures yet. 6. No recordable change of vegetation cover noted. 7. Re-wetting has consolidated suitable conditions for expected habitat development.
Clonad	2021/2022	1. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and dry heather dominated vegetation. 3. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 4. Bog remnant – Raised bog - Annex I degraded raised bog present. Expected to improve in condition.			5. Conditions across site changed somewhat – site re-wetted in places. Some measures still to implement. 6. No indications of recent changes to more established habitats in response to EDRRS measures yet. 7. No recordable change of vegetation cover noted yet. 8. More time needed to evaluate planned re-wetting across this site.
Esker	2021/2022	1. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 2. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. 3. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and dry heather dominated vegetation.			4. Conditions across site radically changed – site re-wetted. 5. No indications of recent changes to more established habitats in response to EDRRS measures yet 6. No recordable change of vegetation cover noted yet. 7. The majority of the bog remains as bare peat. 8. Some fresh pioneering vegetation is present in the rehabilitation extent in these bare peat areas but new vegetation cover is very sparse.

Bog Name	Monitoring	Expected Future Habitats	Re-wetting Progress	Trajectory	Observations
					9. Re-wetting has created suitable conditions for expected habitat development.
Mountlucas	2021/2022	1. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 2. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. Potential for some rich fen/*Cladium* fen. 3. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and dry heather dominated vegetation. Some potential for Oak-Ash-Hazel woodland (WN2) on glacial ridges with minimal or no peat.			4. Conditions across targeted area radically changed – site re-wetted. 5. Very little new pioneering vegetation is present in the rehabilitation extent in these bare peat areas. 6. No indications of recent changes to more established habitats in response to EDRRS measures yet. 7. Re-wetting has created suitable conditions for expected habitat development.
Ummeras	2021/2022	1. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and heather dominated vegetation. 3. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. 4. Bog remnant – Raised bog (improving in condition)			5. Conditions across site radically changed – site re-wetted. 6. Approximately 90% of Ummeras remains as re-wetted bare peat and scattered patches of shallow surface water. 7. Very little fresh pioneer vegetation. 8. Re-wetting has created suitable conditions for expected peatland habitat development.
Derrycashel	2021/2022	1. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and heather dominated vegetation. 2. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland. 3. Bog remnant – Raised bog (improving in condition)			4. Conditions across site changed somewhat – site was already re-wetting. Some measures still to implement. 5. No indications of recent changes to more established habitats already present on the bog in response to EDRRS measures yet. 6. No recordable change of vegetation cover noted yet. 7. Re-wetting has consolidated suitable conditions for expected wetland habitat development.
Derrycolumb	2021/2022	1. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and heather dominated vegetation. 3. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland.			4. Conditions across site radically changed – site re-wetted. 5. Some new wetlands with shallow surface water have been noted post the implementation of the EDRRS measures. 6. No indications of recent changes to more established habitats in response to EDRRS measures yet. 7. Very little fresh pioneer vegetation. 8. No recordable change of vegetation cover noted yet. 9. Re-wetting has created suitable conditions for expected habitat development.

Bog Name	Monitoring	Expected Future Habitats	Re-wetting Progress	Trajectory	Observations
Edera	2021/2022	1. Deep peat habitats - mosaic of embryonic raised bog and *Sphagnum*-rich poor fen. 2. Dry cutaway habitats on shallow peat – Birch Woodland, dry grassland, and heather dominated vegetation. 3. Wetland habitats on shallow peat - Mosaic of poor fen, Reedswamp and wet woodland.			4. Conditions across targeted area radically changed – site re-wetted. 5. No indications of recent changes to more established habitats in response to these measures yet. 6. Very little fresh pioneer vegetation. 7. No recordable change of vegetation cover was noted. 8. Re-wetting has created suitable conditions for expected habitat development.

Quadrats

The general objective of quadrat monitoring is to '*Measure longer-term **finer scale** changes in vegetation following rehabilitation under the scheme'* as outlined in other reporting such as the published EDRRS methodology paper.

In total, 55 no. permanent fixed monitoring quadrats were installed across the 11 subject bogs, i.e. 5 quadrats per bog. In all instances, these were linked with piezometers to allow for future correlation with changes in, and establishment of, vegetation communities. Given the distribution of piezometers and the largely bare peat nature of many of the cutover bogs within the study area, a large proportion of the quadrats are dominated by bare peat. Data analysis shows 37 no. of the 55 no. monitoring quadrats installed had percentage cover of 91-100% bare peat. Seven of permanent fixed monitoring quadrats were installed on restored raised bog (i.e. 5 no. at Kellysgrove bog, 1 no. at Clonad and 1 no. at Ummeras bog). Of the quadrats installed on cutover bog (n=48), 41 no. quadrats were on vegetation communities classified as bare peat (i.e. greater than 50% bare peat cover), 4 no. located within Poor fen type vegetation (within habitats of "*Pioneering open habitats and scrub*") and 3 no. quadrats in pioneering Scrub type vegetation, with varying degrees of coverage of Downy birch (*Betula pubescens*) or Willow (*Salix* spp.).

The rate and extent of revegetation of these permanent fixed monitoring quadrats will be monitored during the scheme and provide an insight into the vegetation changes post rehabilitation. In many instances it will also be possible to correlate vegetation changes with rehabilitation measures i.e. Wetland measures and drain blocking (DCT2, DPT2/3) and associated changes in hydrological regimes. In some instances, i.e. DPT4/5, significant alteration of the receiving environment has occurred during the formation of the cell bunding. Although fixed monitoring quadrats located in these areas were dominated by bare peat pre-rehabilitation, there may be some notable initial reduction in species diversity or vegetation cover, although insignificant.

Future permanent fixed monitoring quadrats will aim to cover a greater diversity of vegetation types, building on those installed to date, and will further help to inform responses in vegetation post-rehabilitation.

Wintering Birds

General Objective

The general objective is to '*Establish quality of effects on relative abundance or proportion of species of conservation concern, following scheme implementation'* as outlined in other reporting such as the published EDRRS methodology paper.

Species Richness

Species Richness is presented in Table 1.7. below and is considered 'High' (i.e. between 16 and 20 water bird species were recorded as present) within the study period in respect of four EDRRS Bogs namely Cavemount Bog, Clooniff Bog, Kilmacshane Bog and Turraun Bog. The mean species richness across all EDRRS sites monitored and reported on herein was 11 no. species.

Table 1-7 Wintering Water Bird Species Richness by Study Site

Bog Name	Species Richness	Rank	Evaluation
Belmont	5	0-5	Very low
Boora	12	11 to 15	Medium

Bog Name	Species Richness	Rank	Evaluation
Castlegar	8	6 to 10	Low
Cavemount	16	16 to 20	High
Clooniff	18	16 to 20	High
Derrycashel	13	11 to 15	Medium
Derrycolumb	5	0-5	Very low
Edera	7	6 to 10	Low
Garryduff	13	11 to 15	Medium
Kilmacshane	18	16 to 20	High
Oughter	9	6 to 10	Low
Pollagh	5	0-5	Very low
Turraun	17	16 to 20	High
Ummeras	7	6 to 10	Low

Relative Abundance

Table 1-8 below illustrates the relative abundance of water bird species during EDRRS monitoring for the winter period 2021/22. A total of 6327 no. individuals were recorded across 32 no. different species. Relative abundance was highest overall for Golden Plover *Pluvialis apricaria* (n=3479) although this is heavily influenced by a standalone count of 2800 at Ummeras Bog in November of 2021. Whooper Swan *Cygnus cygnus* is the second most abundant species, followed by Lapwing *Vanellus vanellus*, Greylag Goose *Anser anser* and then Teal *Anas crecca*. Only 6 no. species occurred at relative abundance values of 100 or more birds overall. The occurrence of Greenland White-fronted Geese *A.a. flavirostris* was notable. Abundance was lowest overall for Kingfisher *Alcedo atthis* (n=1), a species which is more likely to associate with silt pond infrastructure rather than the rehabilitation extent.

Table 1-8. Overall Relative Abundance of Water birds across 14 no. sites monitoring during the winter 2021/22 period.

Species	Relative Abundance Winter 2021/22
GP Golden Plover *Pluvialis apricaria*	3479
WS Whooper Swan *Cygnus cygnus*	910
L. Lapwing *Vanellus vanellus*	520
GJ Greylag Goose *Anser anser*	401
T. Teal *Anas crecca*	306
MA Mallard *Anas platyrhynchos*	261
MS Mute Swan *Cygnus olor*	83
SN Snipe *Gallinago gallinago*	67
BH Black-headed Gull *Chroicocephalus ridibundus*	57
WN Wigeon *Anas penelope*	33
RP Ringed Plover *Charadrius hiaticula*	30
TE Sandwich Tern *Sterna sandvicensis*	24
H. Grey Heron *Ardea cinerea*	21
MH Moorhen *Gallinula chloropus*	17

Species	Relative Abundance Winter 2021/22
NW Greenland White-Fronted Goose *A.a. flavirostris*	17
CU Curlew *Numenius arquata*	16
LG Little Grebe *Tachybaptus ruficollis*	16
WA Water Rail *Rallus aquaticus*	12
SV Shoveler *Anas clypeata*	11
GG Great Crested *Grebe Podiceps cristatus*	6
CA Cormorant *Phalacrocorax carbo*	6
TU Tufted Duck *Aythya fuligula*	5
JS Jack Snipe *Lymnocryptes minimus*	4
ET Little Egret *Egretta garzetta*	4
PT Pintail *Anas acuta*	4
CO Coot *Fulica atra*	3
CS Common Sandpiper *Actitis hypoleucos*	3
HW Great White Egret *Ardea alba*	3
GD Goosander *Mergus merganser*	3
WK Woodcock *Scolopax rusticola*	2
RK Redshank *Tringa totanus*	2
KF Kingfisher *Alcedo atthis*	1
Total	**6327**

Summary and Trajectory

The summary table below, summarises findings for the current reporting period and associated bogs. Regarding trajectory, evaluations apply to measurable evidence of changes to the water bird species assemblage characteristics (proportion of species & relative abundance), attributable to rehabilitation. Cognisance is made in this regard to whether water bird usage was known to BNM in the period prior to rehabilitation under the current scheme (established) and further to whether this was long term in duration or recognised publicly (long established). The latter includes recognition of sites under national monitoring schemes such as the Irish Wetland Bird Survey (IWeBS). Numerical targets have not been set for any potential increases in species richness or relative abundance due to the potential for natural interannual variation thus requiring longer term monitoring data beyond the lifetime of the scheme to dampen fluctuations and produce a realistic trend interpretation, to compare against any previously defined target. As the winter period 2020/21 constitutes the first winter of monitoring it is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.It is notable however that wintering wildfowl including Whooper Swan were observed in a number of instances using EDRRS features such as bunded cells, supporting an assertion that the creation of theses features is at least not detrimental to ongoing usage.

Table 1-9 Winter Bird Monitoring Summary. The Trajectory column indicates if there is any objective trajectory evidence in current reporting period in relation to increasing wintering bird richness or abundance.

Bog Name	Monitoring now complete	Trajectory (Y/N)	Notes
Belmont	YR1:2021/22	**N**	1. Some wintering bird usage already established. 2. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.

Bog Name	Monitoring now complete	Trajectory (Y/N)	Notes
Clooniff	YR1:2021/22	**N**	3. Some wintering bird usage already established. 4. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 5. Potential links to EU sites.
Garryduff	YR1:2021/22	**N**	6. Wintering bird usage long established[5]. 7. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 8. Potential links to EU sites.
Kilmacshane	YR1:2021/22	**N**	9. Wintering bird usage long established. 10. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 11. Potential links to EU sites.
Boora	YR1:2021/22	**N**	12. Wintering bird usage long established. 13. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Oughter	YR1:2021/22	**N**	14. No significant wintering bird usage prior to re-wetting 15. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Pollagh	YR1:2021/22	**N**	16. No significant wintering bird usage prior to re-wetting 17. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Turraun	YR1:2021/22	**N**	18. Wintering bird usage long established. 19. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Castlegar	YR1:2021/22	**N**	20. No significant wintering bird usage prior to re-wetting 21. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Cavemount	YR1:2021/22	**N**	22. Wintering bird usage long established. 23. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Ummeras	YR1:2021/22	**N**	24. No significant wintering bird usage prior to re-wetting 25. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Derrycashel	YR1:2021/22	**N**	26. Wintering bird usage long established. 27. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 28. Potential links to EU sites.
Derrycolumb	YR1:2021/22	**N**	29. No significant wintering bird usage prior to re-wetting 30. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Edera	YR1:2021/22	**N**	31. No significant wintering bird usage prior to re-wetting 32. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 33. Potential links to EU sites.

Breeding Birds

The general objective is to '*Establish quality of effects on relative abundance or proportion of species of conservation concern, following scheme implementation as outlined in other reporting such as the published EDRRS methodology paper*'.

Species Richness

A total of 73 no. species was recorded.

Relative Abundance

To investigate species richness, a transect methodology is being utilised to generate a representative sample of breeding birds at each study location. Data is then compiled and an abundance index

[5] Long established is sites where the presence of important or high numbers has been accepted by the previous inclusion of these sites in national standardised monitoring reports such as IWeBS or is known to Bord an Mona. See Crowe 2005.

derived based on maximum transect counts per species during the period April to June inclusive. In 2022, at the subject sites covered herein, we recorded 73 no. different species across 15 no. cutaway bogs included in PCAS, within the April-June inclusive period. Relative abundance was highest for Willow Warbler *Phylloscopus trochilus* (n=451 recorded in total). Other species for which relative abundance was considered noteworthy was Meadow Pipit *Anthus pratensis* (ranked 2nd overall; n=339 recorded), and for instance Sand Martin *Riparia riparia* (ranked 6th overall; n=170 recorded).

Overall relative abundance for species recorded whose index value is 10 no. or more individuals is shown overleaf in Figure 1-2.

Proportion of Species of Conservation Concern

Of the 73 no. species of bird recorded, 71 no. have been assigned a BOCCI4 conservation status of either Green, Amber or Red. The two exceptions are Pheasant *Phasianus colchicus* [redacted] For those assigned a BOCCI4 conservation status they comprise by percentage 56% Green listed species, 26% Amber listed species and 15% Red listed species. Habitats at the study sites could be considered to currently support a substantial number of species of conservation concern directly or indirectly during the breeding season, included within rehabilitated areas such as cells and bunded wetlands. It is hoped that ongoing monitoring will establish whether the proportions of these species change following completion of rehabilitation.

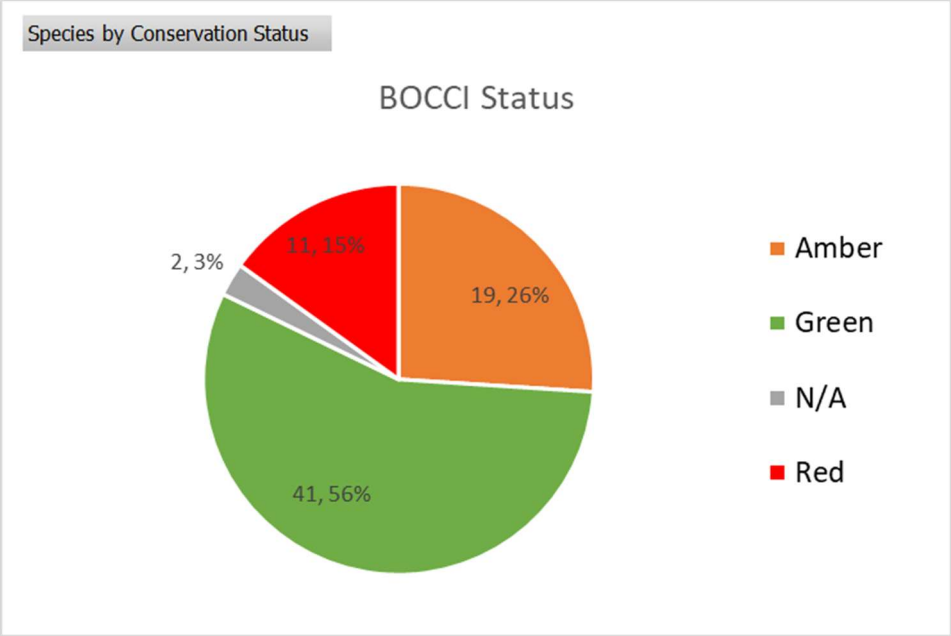

Figure 1-1. Breeding Monitoring Summary. No. of bird species recorded by current Irish Conservation Status (BOCCI)

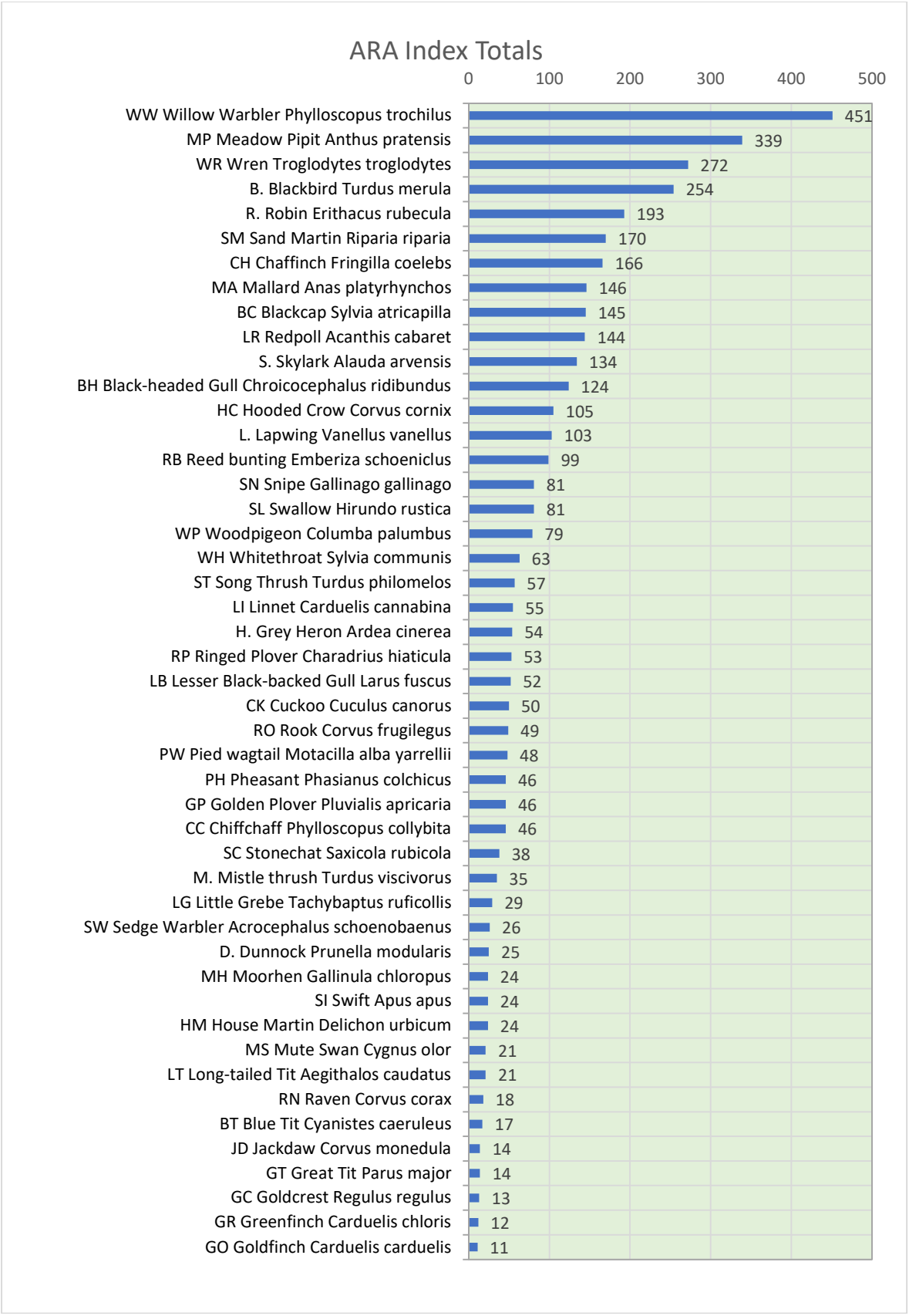

Figure 1-2. Breeding Monitoring Summary. Annual Relative Abundance (ARA) value for species recorded as ten or more individuals.

Habitat Associations

Species recorded during the period April to June inclusive have been assigned a habitat association code from one of two categories namely 'Open' or 'Non-Open'. Associations were interpreted following Nairn & O'Halloran (2012). In broad terms, the category 'Open' was applied to those species most strongly associated with pioneering habitats found on cutaway bog (or intact but ditched raised bog in one instance) whilst species generally associated with scrub and woodland are assigned to the 'Non-Open' category. One species, Wren, has been assigned to both. In 2022 we estimated the species density of the 16 cutaway bogs studied comprised by percentage 66% those of open habitats and 33% those of non-open habitats. Notable open habitat species recorded included waders such as Curlew *Numenius arquata*, Redshank *Tringa tetanus*, Lapwing *Vanellus vanellus*, Ringed Plover *Charadrius hiaticula* and Snipe *Gallinago gallinago*, along with passerine species such as Skylark *Alauda arvensis* and Meadow Pipit *Anthus pratensis* whilst notable non-open habitat species included Willow Warbler *Phylloscopus trochilus*, Goldcrest *Regulus regulus*, Starling *Sturnus vulgaris* and Sparrowhawk *Accipiter nisus*. Certain species recorded (an example would be Swift *Apus apus*) associate with open areas of rehabilitated bogs during their respective breeding season but do not breed on the bog itself. The relative importance therefore of cutaway /raised bog for breeding season foraging or as a refugium may be underestimated for certain species. As further data is collected over the lifetime of the current rehabilitation scheme, we hope to monitor and report further on habitat associations across these bogs. This will support evaluations of the importance of rehabilitated cutaway/raised bog habitats in contributing to future Biodiversity or Nature Restoration initiatives.

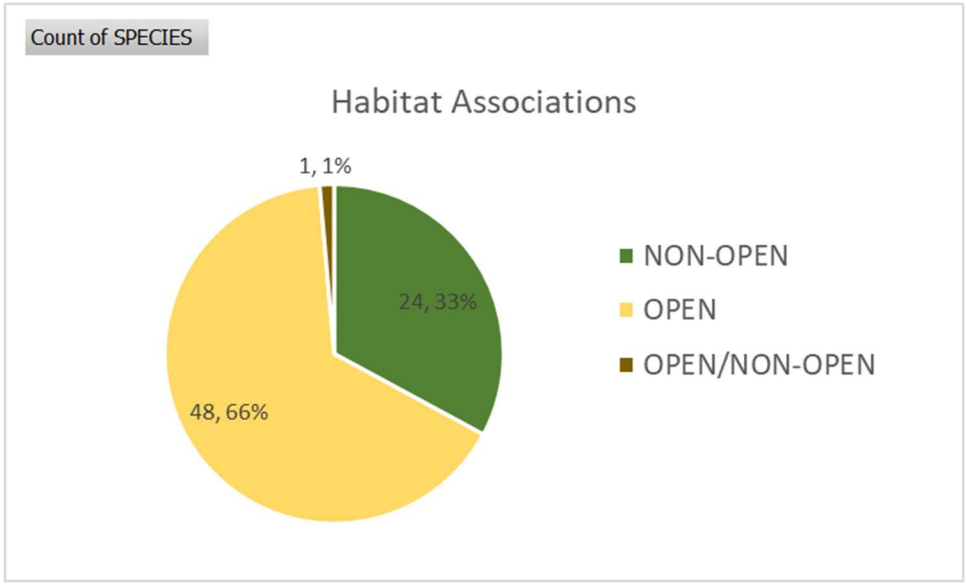

Figure 1-3. Breeding Monitoring Summary. No. of bird species recorded by Habitat Association Category (OPEN, NON-OPEN or both)

Summary and Trajectory

The summary table below overleaf, summarises findings for the current reporting period and associated bogs. Regarding trajectory, evaluations apply to measurable evidence of changes to the breeding bird species assemblage characteristics (relative abundance or proportion of species of conservation concern), attributable to rehabilitation. It is also noted where emerging links to protected sites (i.e. European Sites designated under the Habitats or Wild Birds Directives) have been observed. Cognisance is made in this regard to whether breeding bird usage was known to BNM in the period prior to rehabilitation under the current scheme (established).

Numerical targets have not been set for any potential increases in relative abundance or proportion of species of conservation concern due to the potential for natural interannual variation thus requiring longer term monitoring data beyond the lifetime of the scheme to dampen fluctuations and produce a realistic trend interpretation, to compare against any previously defined target. It is generally too soon (even for sites where data for 2 no. breeding seasons is available) to qualify any long term, permanent change in species richness or abundance directly attributable to EDRRS. However increases have been observed for Black-headed Gull *Chroicocephalus ridibundus*, Ringed Plover *Charadrius hiaticula*, Little Grebe *Tachybaptus ruficollis* and Lesser black-backed Gull *Larus fuscus* (Edera Bog) which can be attributed to rehabilitation or rise in water tables (these species have strong affinities with open water and a step change in surface water presence is often immediate post implementation of measures). The regular usage of Edera Bog by Lesser black-backed Gull is of note as it occurs as a Special Conservation Interest (SCI) within an immediately adjacent Special Protected Area (SPA). [redacted]

Overall it is noted that breeding bird data presented here comprises a representative sample insofar as the 16 bogs under review do not comprise all the sites rehabilitated (nor surveyed as some bogs surveyed in 2022 will be reported on as part of the next reporting cycle) at the time of writing. Further detail is presented on breeding waders specifically in each bog account later in this report. It is possible that changes in abundance or proportion of species of conservation concern could be more marked at other bogs for which data is not available or has not yet been reported.

Table 1-10 Breeding Bird Monitoring Summary. The Trajectory column indicates if there is any objective trajectory evidence in current reporting period in relation to increasing wintering bird richness or abundance.

Bog Name	Monitoring now complete	Trajectory (Y/N)	Notes
Belmont	YR1:2022	N	1. Some wetland breeding bird usage already established. 2. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Clooniff	YR1:2022	N	3. Some wetland breeding bird usage already established. 4. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 5. Potential links to EU sites.
Garryduff	YR1:2022	Y	6. Some wetland breeding bird usage already established. 7. Possible increase in breeding numbers of Snipe since re-wetting. 8. Potential links to EU sites.
Kellysgrove	YR1:2022	N	9. Some breeding peatland bird usage already established. 10. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Kilmacshane	YR1:2022	N	11. Some wetland breeding bird usage already established. 12. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 13. Potential links to EU sites.
Boora	YR1:2022	Y	14. Some wetland breeding bird usage already established. 15. Black-headed Gull Colony newly established, [redacted]

Bog Name	Monitoring now complete	Trajectory (Y/N)	Notes
Oughter	YR1:2021 YR2:2022	Y	**16.** Some wetland breeding bird usage already established. **17.** Black-headed Gull Colony newly established, [redacted]
Pollagh	YR1:2022	N	18. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Turraun	YR1:2022	N	19. Some wetland breeding bird usage already established. 20. [redacted]
Castlegar	YR1:2022	N	21. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Cavemount	YR1:2022	N	22. Some wetland breeding bird usage already established. 23. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Clonad	YR1:2022	Y	24. Black headed Gull Colony newly established
Mountlucas	YR1:2022	N	25. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Ummeras	YR1:2022	N	26. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS
Derrycashel	YR1:2022	N	27. Some wetland breeding bird usage already established. 28. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Derrycolumb	YR1:2021 YR2:2022	Y	29. Increase in breeding Ringed Plover. 30. Potential links to EU sites.
Edera	YR1:2022	N	31. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS. 32. Potential links to EU sites.

Pollinators

The general objective is to '*Show change in species abundance and diversity post-restoration following vegetation establishment/change'* as outlined in other reporting such as the published EDRRS methodology paper[6].

Abundance and Diversity

Abundance in terms of overall numbers of Butterfly species are presented below (Table 1-11) in respect of the 16 no. EDRRS sites[7] included in the current reporting period. On average 7 no. species of Butterfly was recorded per study site (range = 3-12). Species diversity was highest at Cavemount Bog (2021) and Blackwater Bog (2022).

Table 1-11 Pollinator Survey Butterfly Index Values

EDRRS Site	Species Index Value
Blackwater Year 1	10
Cavemount Year 1	8
Cavemount Year 2	6

[6] Supporting Material - BNM Peatlands Climate Action Scheme (bnmpcas.ie)

[7] For the purposes of the present report each year of survey at any given bog is treated as a separate 'site'.

EDRRS Site	Species Index Value
Edera Year 1	1
Castlegar Year 1	9
Castlegar Year 2	5
Oughter Year 1	8
Oughter Year 2	7
Lodge Year 1	12
Clooniff Year 2	7
Begnagh Year 1	4
Clonad Year 1	9
Clonad Year 2	3
Derrycolumb Year 1	10
Ummeras Year 1	4
Pollagh Year 1	3

Four species of Bee and 3 no. species of Moth were also recorded from transects. See individual bog reports for further information and details of any additional casual observations. Abundance was highest overall for Meadow Brown *Maniola jurtina*, followed by Small Tortoiseshell *Aglais urticae* and then Common Blue *Polyommatus icarus* butterflies. See Table 1-12, below. Although not included in formal transect surveys, we note that a high count of 23 no. Large Heath *Coenonympha pamphilus* butterfly was recorded from Kellysgrove Bog in June of 2022. This is potentially notable as a comparator in the context of further 'high bog' sites due to be rehabilitated in future years.

Table 1-12 Pollinator Survey Butterfly Abundance totals

Species	Total
Meadow Brown *Maniola jurtina*	132
Small Tortoiseshell *Aglais urticae*	104
Common Blue *Polyommatus icarus*	70
Ringlet *Aphantopus hyperantus*	57
Small White *Pieris rapae*	46
Green-veined White *Pieris napi*	37
Speckled Wood *Pararge aegeria*	24
Orange Tip *Anthocharis cardamines*	23
Large White *Pieris brassicae*	20
Small Copper *Lycaena phlaeas*	16
Peacock *Aglais io*	12
Small Heath *Coenonympha pamphilus*	8
Cryptic Wood White *Leptidea juvernica*	5
Brimstone *Gonepteryx rhamni*	3
Red Admiral *Vanessa atalanta*	3
Wall Brown *Lasiommata megera*	3
Dark Green Fritillary *Speyeria aglaja*	1
Painted Lady *Vanessa cardui*	1
Silver-washed Fritillary *Argynnis paphia*	1

Summary and Trajectory

Numerical targets have not been set for any potential increases in relative abundance or proportion of species of pollinators due to the heterogenous nature of cutaway, potential for natural interannual variation, and the absence of published baseline data on comparative invertebrate diversity of cutaway bogs (no precedent is known which derives say inverterbrate diversity indexes for cutaway either pre- or post rehabilitation). Given anticipated vegetation succession rates longer term monitoring data beyond the lifetime of the scheme is required to effectively produce a realistic trend interpretation, to compare against any previously defined target. On this basis a simple increase in species diversity (Index Value) and/or the establishment of species of known conservation concern post rehabilitation is seen as indicative of a successful trend.

At present however, it is generally too soon (even for sites where data for 2 no. seasons is available) to quantify any long term, permanent change in species richness or abundance directly attributable to EDRRS. For instance, at four sites for which YR1 and YR2 Butterfly data is being reported herein (Cavemount, Castlegar, Oughter and Clonad), all have had minor declines in the overall number of species recorded between Years 1 and 2 of the scheme (Table 1-11). This is assumed to reflect other variables such as natural interannual variation, or weather conditions, rather than any effect from rehabilitation/vegetation succession. It is known that some of the bogs for which data is presented have additional species of Butterfly which have not to date been recorded 'on transect' (Blackwater Bog for instance has a colony of Grayling *Hipparchia semele* which would be notable in the County Offaly context). The present monitoring is effectively the first study to potentially look at Pollinator diversity in this scenario and it is hoped the evidence base produced will demonstrate benefits to Pollinators post rehabilitation/commencement of a return to a naturally functioning ecosystem, including the spread to rehabilitated areas of other species known to already occur at subject sites.

Table 1-13 Pollinator Monitoring Summary. The Trajectory column indicates if there is any objective trajectory evidence in current reporting period in relation to increasing wintering bird richness or abundance.

Bog Name	Monitoring now complete	Trajectory (Y/N)	Notes
Clooniff	YR1: 2022	N	1. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Oughter	YR1:2021 YR2:2022	N	2. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Castlegar	YR1:2022	N	3. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Cavemount	YR1:2021 YR2:2022	N	4. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Clonad	YR1:2021 YR2:2022	N	5. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Ummeras	YR1:2022	N	6. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Derrycolumb	YR1:2021 YR2:2022	N	7. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.
Edera	YR1:2022	N	8. It is too soon to establish any increase in species richness or abundance directly attributable to EDRRS.

1.2.3 Carbon Flux

Carbon monitoring on EDRRS peatland sites has the overall aim of quantifying changes in peatland carbon fluxes which are the result of rehabilitation measures. To accomplish this, baseline emissions must first be estimated from Bord na Mona sites that have yet to be rehabilitated. In conjunction with this, future carbon fluxes (those which are altered due to restoration measures) must be modelled based on measurements taken on sites assumed to be representative of future conditions. By quantifying both baseline and future carbon fluxes, the net change in fluxes can be estimated.

The greenhouse gases (GHGs) to be monitoring over EDRRS include Carbon Dioxide (CO_2), Methane (CH_4), in addition to aquatic carbon losses Dissolved Organic Carbon (DOC) and Particulate Organic Carbon (POC). A mixture of monitoring techniques is employed to estimate current and future fluxes from Bord na Mona peatlands. These include the eddy covariance flux tower measurements to measure real time CO_2, CH_4 fluxes from bare peat sites and the immediate response to restoration measures. Closed static chamber measurements are also conducted at a range of vegetation types to determine emission factors from vegetation that is currently found on existing Bord na Mona land and are anticipated to colonise following rehabilitation (discussed in more detail in Section 3.0). Lastly, two flumes will be installed (anticipated to be completed in November 2022) at the same bogs as the eddy covariance towers and these will measure flow and DOC (via DOC sonde) in real time. POC measurements will be obtained via grab samples. Additionally, grab samples of DOC and POC are taken as part of the enhanced surface water monitoring program throughout EDRRS bogs and these will be integrated into the carbon monitoring analysis.

Two Eddy Covariance Towers are deployed on bare peat/industrial extraction sites. In conjunction with this, a suite of hydro-meteorological observations is also collected. The sites that eddy covariance monitoring will occur were selected based on an analysis of Bord na Mona peat depths across sites. Using the output from ground penetrating radar (GPR) and Lidar surveys, EDRRS peatland depths were estimated for approximately 27,000 hectares. From this preliminary geospatial analysis, it found that peat depths were distributed between shallow (<1.5m), intermediate peat depths (>1.6m and <2.5m) and deep peat (2.5m+). Based on these results, it was decided to locate the flux towers at a deep peat site (location to be determined) and a shallow peat site (Ballaghurt Bog, Co. Offaly). The shallow peat site is now operational.

To establish emission factors for current and future habitats, a combination of data sources will be utilised and analysed geospatially. The purpose of this analysis to identify the most frequently occurring vegetation based on characteristics like peat depth, wetness, and chemistry (e.g. pH). This analysis will be used to inform upon the trajectory that bare peat sites are like to follow. Using this output, future habitat maps will be refined, and geographic statistics will be produced to estimate areal coverage of important vegetation categories.

Carbon monitoring is not proposed for all bogs and is therefore not addressed on a bog by bog basis in Section 2 below. The estimation of GHG fluxes will be accomplished from the application of emission factors obtained from monitoring on other Bord na Móna peatlands and this is described in more detail in Section 3 of this report.

1.2.4 Surface Water Monitoring

Surface water monitoring is required under Bord an Móna's Integrated Pollution Control (IPC) Licences issued by the Environmental Protection Agency (EPA) However the licence obligation of a quarterly sampling regime on a selected number of locations was not considered sufficient to appropriately track the changing water chemistry that will occur as part of this enhanced rehabilitation programme. The frequency and extent of sampling has been increased under the scheme so that circa 70% of each bog's drainage catchments are monitored on a monthly basis.

The parameters monitored are as per condition 6.2 of the IPC Licence and include monthly monitoring for pH, Suspended Solids, Total Solids, Total Phosphorus, Total Ammonia, Colour & COD (chemical oxygen demand). In addition, DOC (dissolved organic carbon) has been included as a parameter to identify changes in carbon in the surface water.

Initial surface water monitoring results are discussed on a bog by bog basis in Section 2 below.

1.2.5 Flow Monitoring

Flow monitoring is carried out at some locations but is not an integral part of the monitoring programme for EDRRS bogs. The flow monitoring provided under EDRRS can be summarised as follows:

1. Provision of flumes as part of the carbon monitoring regime;
2. Monitoring of flow using probes located in an outfall pipe;
3. Monitoring of flow from a number of composite samplers located on Bord na Móna bogs;

Flow monitoring is not proposed for all bogs and therefore is not addressed on a bog by bog basis in Section 2 below. Details of installation of flumes is included in Section 3 and details of other flow monitoring is discussed in Section 4 of this report.

1.2.6 Archaeology

In advance of the commencement of the rehabilitation, Bord na Móna engaged a Project Archaeologist to undertake a desk based study of all available surveys and excavations on the EDRRS bogs in question. This archaeological impact assessment (AIA) report was prepared by Dr. Charles Mount for Bord na Móna Energy Ltd to fulfil this characterisation in relation to archaeological heritage. It represents the results of a desk-based assessment of the impact of proposed bog rehabilitation on the known archaeological heritage of the bog.

This is a desk-based archaeological assessment that includes a collation of existing written and graphic information to identify the likely archaeological potential of each bog.

This area was examined using information from:

1. The IAWU Peatland Survey 1991
2. Bord na Mona Re-assessment survey 1999
3. The Sites and Monuments Record that is maintained by the Dept of Housing, Local Government and Heritage
4. The topographical files of the National Museum of Ireland

5. Archaeological monitoring
6. The Excavations database
7. Previous assessments

Monitoring of Archaeology is outside the scope of EDRRS however the National Monuments Service engaged the services of AMS Archaeological Management Solutions Ltd. to carry out site monitoring at a number of the Year 1 bogs while the rehabilitation measures were implemented. The outcome of this monitoring is not included in this report however Section 2 below will identify where this monitoring was carried out in the EDRRS Year 1 bogs.

Bord na Móna operates under an agreed Code of Practice regarding archaeology with the Department of Arts, Heritage and the Gaeltacht and the National Museum of Ireland. Under the Code Bord na Móna, the Minister and Director work together to ensure that appropriate archaeological mitigation is carried out in advance of peat extraction. While this activity is not peat extraction, Bord na Móna, National Museum of Ireland and National Monuments Service continue to operate under the relevant good archaeological practice elements of this code.

1. Bord na Móna must ensure that any monuments or archaeological objects discovered during peat extraction are protected in an appropriate manner by following the Archaeological Protection Procedures.
2. Bord na Móna must ensure that any newly discovered monuments on Bord na Móna lands are reported in a timely manner to the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht.
3. Bord na Móna must ensure that any archaeological objects discovered on Bord na Móna lands are reported immediately to the Duty Officer of the National Museum of Ireland.

Bord na Móna will adhere to the Archaeology Code of Practise relating to management of any archaeological finds that may arise during cutaway peatland rehabilitation and decommissioning.

Details of any such finds on the EDRRS Year 1 bogs are recorded in Section 2 below.

1.2.7 Aerial Imagery/ LiDAR

Aerial imagery from 2017/2020 was available for the Bord na Móna bogs included in EDRRS and this imagery was purchased at the commencement of the scheme. In order to determine the range of elevations across the bogs prior to the commencement of rehab measures, LiDAR (Light Detection and Ranging) was used. LiDAR is a remote sensing system that uses light from an aircraft to measure distance and generates a topographical survey of the land. This information was gathered from aircraft over flying the bogs and as aerial imagery was already available, the bogs could be flown at night for this purpose.

Following the completion of the first year of the scheme implementation, the EDRRS Year 1 bogs were flown in Summer 2022 to capture new aerial imagery and also updated LiDAR information. The aerial imagery demonstrates the location of the peat drain blocks, the rehabilitated cells and also gives an indication of the standing water on the bog. These changes are visible from the two images of the same location below in the figures below:

Figure 1.4: Sample of Aerial Imagery – Prior to rehabilitation

Figure 1.5: Sample of Aerial Imagery available – Post Rehabilitation

The LiDAR provides updated elevations across each of the Year 1 bogs, and also maps berm and bunded cell heights. A summary of the aerial imagery and LiDAR survey dates are referenced for each bog in Section 2 below and a summary table is also included in Appendix U of this report.

A dashboard is currently being developed to show the rehabilitation status across each bog in the scheme and this aerial imagery will be available to view on this dashboard. Images of this dashboard are included in Appendix U of this report.

2. Monitoring by Bog

A total of nineteen bogs were approved for rehabilitation in 2021. Rehabilitation under EDRRS commenced in April 2021 although some small scale preliminary trials were carried out in Castlegar Bog prior to this. Some mobilisation measures were carried out in Clooniff Bog in 2021, however rehabilitation was postponed on this bog until 2022. The level and type of monitoring carried out under EDRRS varies from bog to bog and the following sections summarises the monitoring by bog. Drawings and monitoring data for these bogs is included in Appendices B to T of this report.

2.1 Belmont Bog

Belmont Bog in Co. Offaly is located one kilometre north-west of Belmont Village and the overall area of the bog is 320 hectares. Some of this area is constrained and not included for rehabilitation due to existing forestry leases and domestic turfcutting. The bog had been in peat production since the 1960's and industrial peat extraction ceased in 2018. Further information on the bog is available in the Belmont Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Belmont Bog commenced in June 2021 and this rehabilitation was 89% complete at the end June 2022.

2.1.1 Hydrological monitoring

Hydrological monitoring is ongoing at Belmont bog. A total of 15 Phreatic wells have been installed, where 6 Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. DR-22-12-32 in Appendix B. A total of four monitoring visits have been carried out to date at Belmont bog as outlined in Appendix B1 - Belmont Bog - Hydrological Monitoring, with manual dipping completed in August 2021, February 2022, and logger dipping in August 2022. Monitoring will be ongoing at Belmont bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix B. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 bogs were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data would indicate that water levels were deeper in Summer 2022 than Summer 2021. However, it is clear from logger data that there was a significant increase in water levels over the Winter 2021/22 period, before water levels dropped rapidly in January 2021. This is associated with the creation of outlets to regulate water levels. Summer water levels do still appear to be dropping at some wells in 2022. Monitoring took place at Belmount in August 2022 which was after a prolonged dry spell and it is important not to directly compare two single manual readings without considering weather conditions prior to the readings being recorded. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

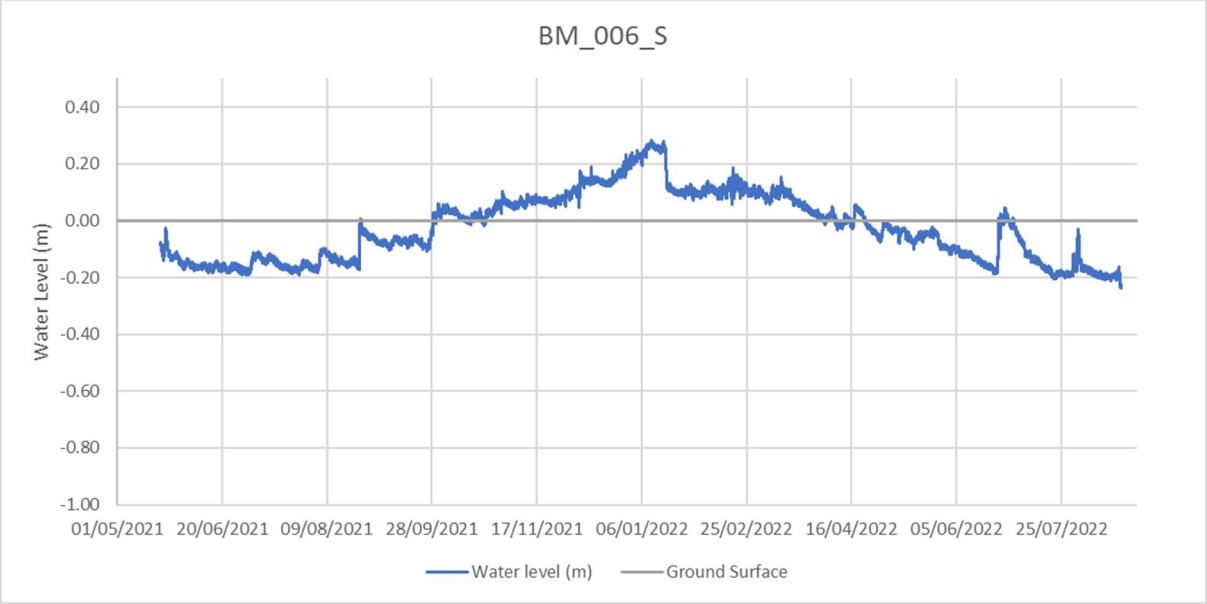

Figure 2.1.1: Hydrograph for monitoring well BM_006s

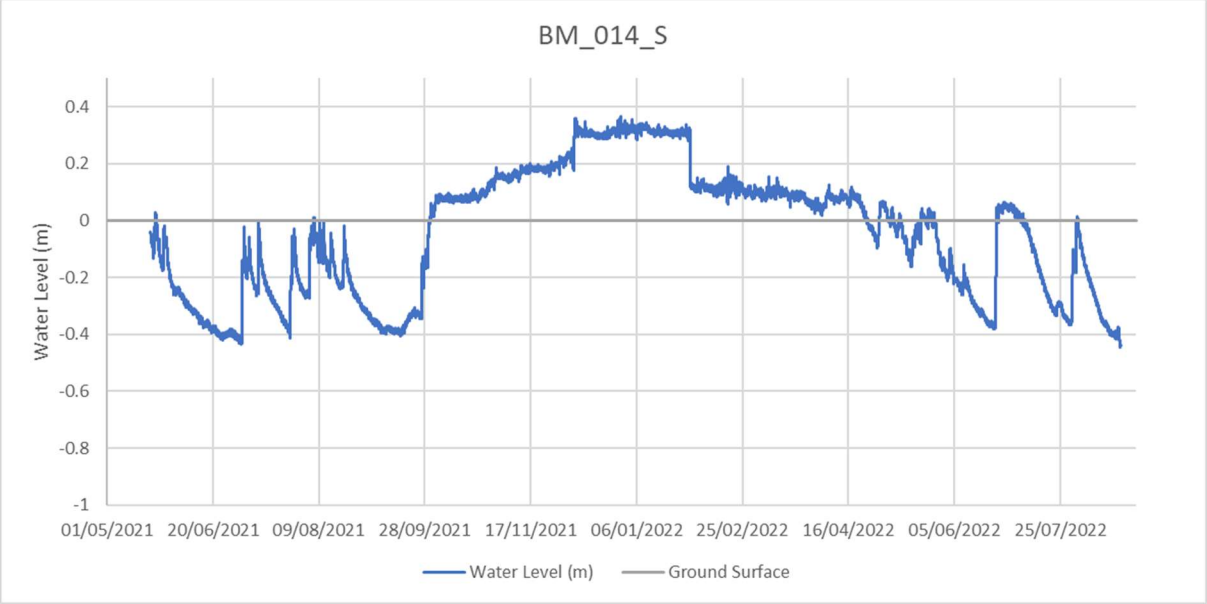

Figure 2.1.2: Hydrograph for monitoring well BM_014s

2.1.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Belmont Bog during summer 2022. Methods following those outlined in Section 1.2.

Constraints

At the time of survey some areas of bare peat in the western section and the south-eastern extent of Belmont had been rehabilitated to form bunded cells. Many of these areas are not safe for access due to standing water or soft conditions and had to be avoided. However, there were still high fields present which were used for access and these areas are at present entirely bare peat with little to no vegetation present.

Results

Belmont Bog developed in two connecting basins, separated by a ridge of high ground that has been developed as a conifer plantation by Coillte. Both sections are partially susceptible to winter inundation from when the adjacent Blackwater River has high water-levels for extended periods.

The northern bog unit is the largest section of cutaway bog. It is orientated northwest-southeast with the Blackwater river flowing along the northwest margin, fringed by a narrow band of riparian vegetation and marginal habitats. The north-western half of the bog can be described as a typical basin bog with high ground around the margins and lower ground towards the centre. Approximately one third of Belmont is still re-wetted bare peat.
The majority of the pioneer cutaway vegetation has developed in this area of the bog, with drier heath and scrub communities developing on the margins and more elevated areas whilst fen, flush and open water communities are forming in the basins. Rehabilitation has taken place in this area of the bog, carried out in 2021.

The following vegetation communities (as per the Bord na Móna classification system) were recorded during the surveys carried out in 2022. Heath and scrub communities which occur on drier ground on shallow peat include – 'Dry *Calluna* community' (dHeath) and 'Emergent *Betula*- dominated community' (eBir). Large open areas of bare peat (community 'Bare peat (0-50% cover)') remain in this area also.

In the wetter basins patches of shallow surface water and poor fen communities have developed including - 'Pioneer *Eriophorum angustifolium* dominated community (poor fen)' (pEang), 'Pioneer *Triglochin palustris*-dominated community' (pTrig) (Poor Fen), pioneer '*Carex rostrata* community' (pRos) , '*Phragmites australis* community' (pPhrag) (Reedbed), 'Pioneer *Juncus effusus* community' (pJeff) (Poor Fen) and open water ('Permanent pools and lakes' or OW).

Belmont is also characterised by having one of the largest areas of pioneer cutaway vegetation dominated by Black Bog-rush (*Schoenus nigricans)*, found in the NW section of Belmont, with other indicator species such as Common Butterwort (*Pinguicula vulgaris)* and *Sphagnum subnitens* present. This is an unusual and scarce pioneer cutaway vegetation type and is generally thought to be an indicator of alkaline ground-water influence and potential rich fen development in the future. Other calcareous indicator species recorded at Belmont include Saw Sedge (*Cladium mariscus)* and Stoneworts (*Chara* sp.)

Two relatively large gravel mounds (exposed by peat extraction) are present in Belmont in the centre of the site, as well as several smaller lower mounds. One of these mounds (Derries Hill) was planted with Oak (*Quercus* sp.) and Sitka Spruce (*Picea sitchensis*) in the 1960's-1970's. Gravel is also exposed around the site in several places, particularly along the north-west margin.

The majority of southern section is currently bare peat formed into bunded cells, following rehabilitation in 2021. Some pioneer open habitats and scrub communities have formed predominantly 'Pioneer *Eriophorum angustifolium* dominated community' (pEang), and/or 'Pioneer

Juncus effusus community' (pJeff) (Poor Fen) along with reedbeds or '*Phragmites australis* community' (pPhrag) forming in wetter areas. Open water ('Permanent pools and lakes' or OW) occurs in the low-lying basins in this part of the bog.

It is too soon for habitats at Belmont to reflect post rehabilitation change or succession. Approximately one third of Belmont remains as bare peat. Some fresh pioneering vegetation (since rehab was carried out) is present in the rehabilitation extent in these bare peat areas but vegetation cover is very low (see also Quadrat survey results, below). Some areas of the bog already have well established pioneer vegetation including poor fen and alkaline fen. These habitats are expected to continue to develop post rehabilitation.

Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out or completed so further time is needed for optimum water levels to potentially develop at the surface of these areas.

In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site. The rehabilitation measures that have re-wetted the site will encourage the continued development of fen, wetland and peatland pioneer vegetation at this site.

Figure 2.1.3 Bare peat recolonising with Pioneer *Eriophorum angustifolium* dominated community developing

Figure 2.1.4 Dry heather dominated vegetetaion in the north-west of the bog.

Figure 2.1.5 Pioneer *Eriophorum angustifolium* dominated community with reedbeds in the background.

Figure 2.1.6 Pioneer *Carex rostrata* dominated community and scrub.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Belmont bog during summer of 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were noted.

Results

Quadrats Q1, Q2, Q3 & Q4 are located on bare peat dominated cutaway bog. Quadrat 4 was located adjacent to an expanding reed bed and therefore included some *Phragmites australis*. Quadrat Q5 is located in an area of pioneering vegetation dominated by *Eriophorum angustifolium* and a significant area of bare peat. See Table 1 of Appendix B2 for detailed quadrat data. A sample of quadrats is shown below.

Figure 2.1.7: Quadrat Q4

Figure 2.1.8: Quadrat Q5

Discussion

Quadrats reflect baseline conditions and at this stage it is too soon to infer any changes to quadrat vegetation cover as a result of intervention under the scheme. As with habitats the quadrats reflect the current baseline conditions following rehabilitation. Further time is required before any vegetation is likely to be recorded.

Winter Birds – Monitoring YR1

Method

Seven counts within the winter period 2021/22 were conducted. All counts were within the period 09:45 to 17:30. Counts were undertaken generally on days with no rain but on three dates showers were noted. Visibility was always good and wind speeds ranged from F1-F5. Survey dates were 21 September 2021, 21 October 2021, 24 November 2021, 15 December 2021, 12 January 2022, 23 February 2022 and 10 March 2022.

Constraints

On several visits EDRRS activities were still ongoing, particularly around cells in the SE of Belmont.

Results – Species Richness

A total of 5 water bird species were recorded across all surveys. One of these was a BOCCI (Gilbert *et al.* 2021) Red listed species namely Snipe. Three Amber listed species were recorded namely Mallard, Mute Swan, and Whooper Swan.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.1.1 and was highest for Mallard (n=6) although this was influenced by a peak count of 25 in October of 2021. Average abundance across all 7 counts was <5 for all remaining species.

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Belmont Bog. Whooper Swans recorded in October of 2021 were recorded flying over and using Belmont Bog, but these may have been disturbed from elsewhere.

Discussion

Regarding overall species richness is considered very low during the period studied. No counts were recorded which reached potentially important thresholds for species of conservation concern. The wintering bird species assemblage is similar to previous bird surveys carried out by Bord na Móna. No change in species richness and abundance can be attributed to the rehabilitation so far.

Four species recorded were of Red or Amber status. In the context of nearby European Sites which have for instance '*Wetland and Waterbirds'* as qualifying interests a post rehabilitation Belmont may contribute to further habitat for SCI species and support the conservation objectives for these European Sites, in particular in conjunction with the adjacent Blackwater Bog, which will also see rehabilitation under the scheme. [redacted] The data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds at this site.

Table 2.1.1: Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	Mean	Max
MA Mallard *Anas platyrhynchos*	Amber	0	25	8	0	0	3	0	6	25
MS Mute Swan *Cygnus olor*	Amber	4	0	0	0	0	0	0	1	4
SN Snipe *Gallinago gallinago*	Red	2	1	5	0	0	2	0	2	5
WS Whooper Swan *Cygnus cygnus*	Amber	0	0	19	0	2	0	0	4	19
H. Grey Heron *Ardea cinerea*	Green	2	0	1	0	0	0	1	1	2

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 3 no. transects (each 1km in length) which was visited two times in the period April to June 2022 inclusive. Refer to Section 1.2 for survey methodology in respect of CBS. All counts were completed within the period 07:30-09:30. All counts were conducted in suitable weather conditions comprising zero rain, good visibility and zero wind. See Figure in Appendix B2 titled '*Belmont Bog Ecology Transects'* for transect information.

Constraints

Due to their location, sampling results may occasionally include species which utilise the areas adjacent to transects but which are not subject to rehabilitation. Where relevant this is further addressed in the discussion section. There were no further constraints.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 21 no. species were recorded, see Table 2.1.2. This included three BOCCI (Gilbert *et al.* 2021) Red listed species; Lapwing, Black-headed Gull and Swift, along with 2 no. BOCCI Amber listed species namely Mallard and Willow Warbler. Remaining species (n=16) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

No bespoke breeding wader survey was undertaken, however data for the period mid-April to late May indicates 2 breeding pairs of Lapwing were present (interpretation following O'Brien and Smith 1992).

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species across visit one and two or within the period April to June inclusive, see Table 2.1.2. This allows for future comparison with CBS trends which takes the same approach to index species. A colony of Rooks on adjacent farmland (25 birds observed) is not included in the ARA index, colonies are recorded separately in CBS and in this instance the colony is not located onsite. Abundance was highest for Willow Warbler (n=11) and no other species occurred in numbers of 10 or more (range 1-8).

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Twelve species considered associated with NON-OPEN

habitats were recorded, 8 species associated with OPEN habitats and 1 species associated with both categories were recorded see Table 2.1.2.

Results – Colonial Species

As mentioned, a colony of Rooks comprising 25 individuals was recorded in April of 2022.

Discussion

The occurrence on cutover or raised bog of many of the species recorded in this study have been previously described in literature such as Wilson (1990), Bracken *et al.* 2008, or Copland *et al.* 2008 and in unpublished reports such as Copland (2010).

Only 25 species were recorded of which 5 are considered currently of conservation concern. The occurrence of Red listed species Lapwing is of note. Another Red listed species recorded, Swift, is not likely to breed at Belmont as no suitable habitat for nesting is present however the use of the site for foraging is notable and indicates the potential resources available following rehabilitation for this declining species. Abundance was highest for Willow Warbler at Belmont but there is substantial forestry onsite and numbers of this species reflect the habitats sampled via the methodology.

Regarding habitat, open habitat species comprise all either Red or Amber listed species (5 no. in total). Openness of habitat has previously been suggested as an important habitat feature, benefitting species of conservation concern (Copland 2009) on cutaway, and results of this study suggest this is also the case at Belmont. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway bogs. The breeding bird species richness and abundance at Belmont in the first year post rehabilitation is considered similar to results previous bird surveys carried out by Bord na Móna. No change in species richness and abundance can be attributed to the rehabilitation so far at Belmont.

Table 2.1.2: Breeding 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	5
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	2
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	1
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	3
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	7
CK Cuckoo *Cuculus canorus*	Green	OPEN	3
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
GT Great Tit *Parus major*	Green	NON-OPEN	2
HC Hooded Crow *Corvus cornix*	Green	OPEN	8
L. Lapwing *Vanellus vanellus*	Red	OPEN	7
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	1
MA Mallard *Anas platyrhynchos*	Amber	OPEN	5
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	1
PW Pied wagtail *Motacilla alba yarrellii*	Green	OPEN	1
R. Robin *Erithacus rubecula*	Green	NON-OPEN	6
SC Stonechat *Saxicola rubicola*	Green	OPEN	5
SI Swift *Apus apus*	Red	OPEN	2
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	2
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	4
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	2
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	11

Pollinators

No pollinator surveys were scoped for Belmont Bog under agreed scheme Monitoring and Verification.

2.1.3 Surface water quality

Belmount bog has two treated surface water outlets, both to the Blackwater (Shannonbridge) 020 IE_SH_25B270200. One of these outlets is monitored as part of EDRRS (Ref. SW84) and the location of this outlet is shown on Drawing No. BnM-DR-22-13-32 in Appendix B.

Analysis of available monitoring over the past 5 years of the IPC licence environmental monitoring programme when this bog was in active production, indicate that relevant parameters like Suspended Solids had an average of 4.4 mg/l, with Ammonia averaging 0.67 mg/l, as per results below.

Table 2.1.1 Belmont Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS mg/l	TS mg/l	Ammonia mg/l	TP mg/l	COD mg/l	Colour
Belmount Bog	SW-84	Q3 20	7.7	7	458	0.033	0.05	51	194
Belmount Bog	SW-84	Q4 20	7.3	>2	219	0.073	0.05	83	269
Belmount Bog	SW-84	Q4 20	7.1	>2	178	0.111	0.05	81	377
Belmount Bog	SW-81	Q4 18	7.9	5	226	0.72	0.05	50	134
Belmount Bog	SW-84	Q4 18	6.6	5	270	3.4	0.05	85	283
Belmount Bog	SW-81	Q3 15	8.1	5	410	0.16	0.05	23	99
Belmount Bog	SW-84	Q3 15	7.7	5	354	0.21	0.05	66	206

Monthly EDRRS baseline monitoring commenced in August 2020, which gave 20 sampling events for this report, up to June 22. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 4mg/l. Similarly, Ammonia had an average of 0.115 mg/l, which is less than when the bog was in active production and trended flat. Belmount rehabilitation commenced in June 2021 and since then overall trends remained flat during the period with no obvious clear relationship between rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.4

Surface water monitoring for the period and associate graphs are in Appendix B.

2.1.4 Archaeology

This bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. There were no known archaeological sites identified during the Archaeological Impact Assessment.

2.1.5 Aerial Imagery / LiDAR

Aerial imagery for Belmont Bog available prior to the commencement of the rehabilitation dates from April 2020. A LiDAR aerial survey was carried out in December 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Belmont Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.2 Clooniff Bog

Clooniff Bog is located approximately 4 km to the north of Shannonbridge in Co. Roscommon, on the western banks of the River Shannon and the overall area of the bog is 531 hectares. Peat production at Clooniff Bog commenced in the 1970's, with all commercial peat extraction ceasing in 2019. Further

information on the bog is available in the Clooniff Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. While approval for the rehabilitation of Clooniff was obtained in 2021 rehabilitation did not commence until April 2022. This rehabilitation was 76% complete at the end June 2022.

2.2.1 Hydrological monitoring

Hydrological monitoring is ongoing at Clooniff bog. A total of 26 Phreatic wells have been installed, where 10 Phreatic wells have been instrumented with automated loggers. 3 deep pipe wells have been installed. Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. DR-22-07-32 in Appendix C0. A total of four monitoring visits have been carried out to date at Clooniff bog as outlined in Appendix C1 - Clooniff Bog - Hydrological Monitoring, with manual dipping completed in May 2021, July 2021, January 2022, and August 2022. Monitoring will be ongoing at Clooniff bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works at Clooniff Bog, rehabilitation measures that would have an impact on ground water levels have yet to be completed on Clooniff Bog and also unlike other EDRRS Year 1 bogs the rehabilitation works did not commence until April of 2022 therefore the post rehabilitation data available is quite limited for this bog.

A summary of manual readings is provided in Appendix C1. Limited water table measurements were carried out in Summer 2022 as the EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data does not provide a clear indication of an increase in water table height. In some areas the water table was higher than in 2021, but in many instances the water table was close to or deeper than summer 2021 levels during summer 2022. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data from well CF_001s and CF_005s shows how the water level at the site increased during winter 2021 only to decrease again to similar levels as summer 2021 during the summer of 2022. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

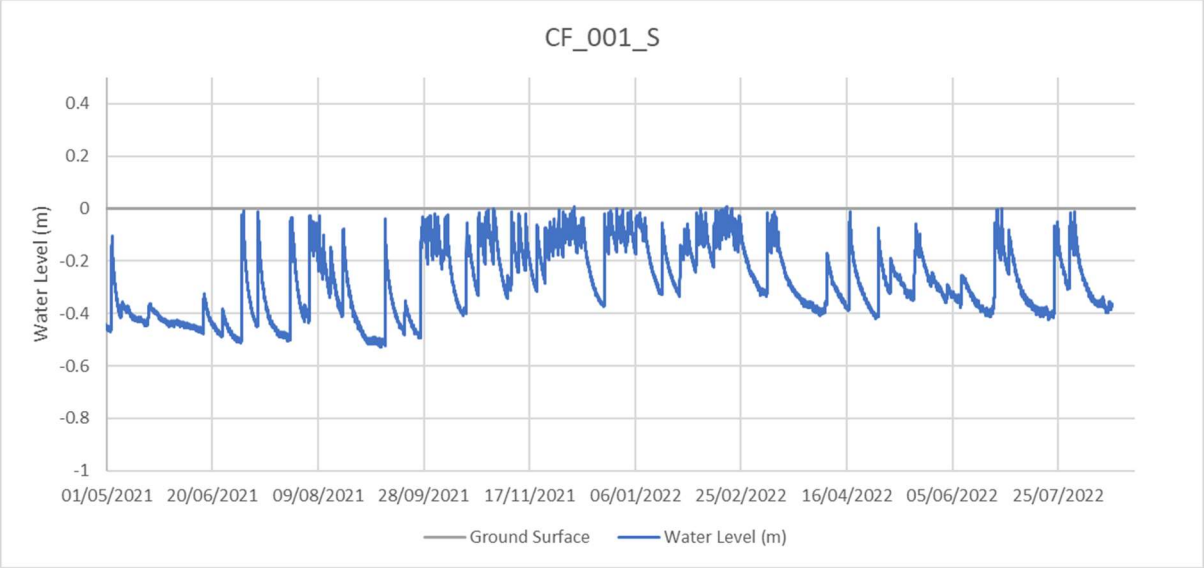

Figure 2.2.1: Hydrograph for monitoring well CF_001s

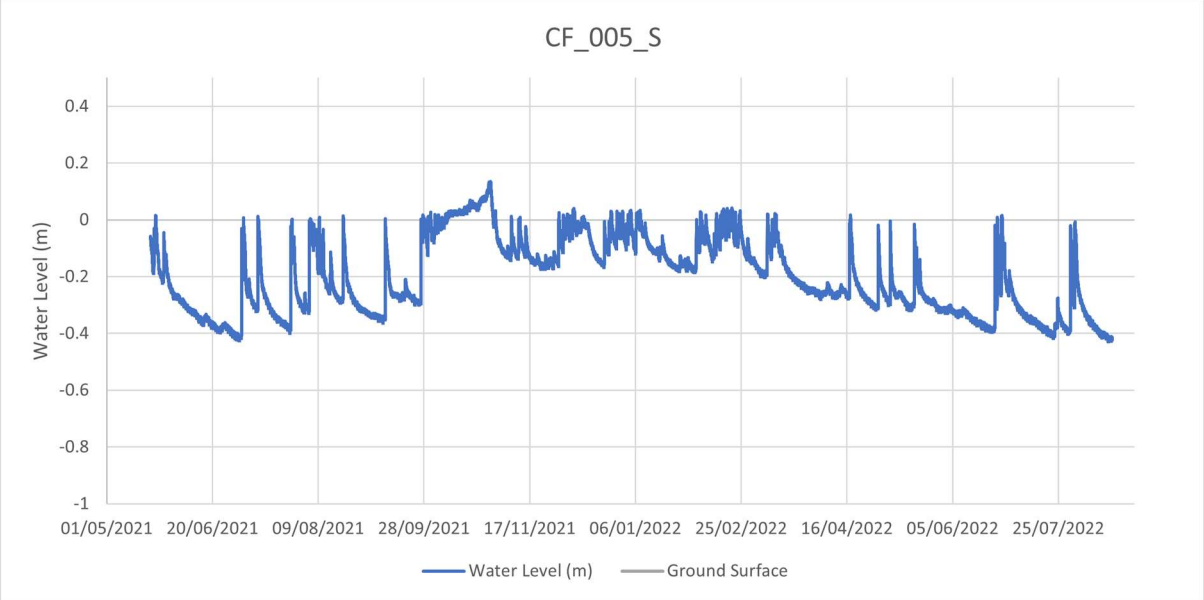

Figure 2.2.2: Hydrograph for monitoring well CF_005s

2.2.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Clooniff Bog during summer 2022.

Constraints

No constraints were noted.

Results

Clooniff bog is divided into four main sections. Clooniff is mainly composed of bare peat as the entire bog was in active peat extraction until recently (2019). The western most sections are dominated by large expanses of re-wetted bare peat, with the north-eastern and eastern most sections establishing pioneering vegetation. However, these areas still support significant areas of bare peat and some open water. Clooniff had a pumped drainage system which has now ceased, and this will have a very significant influence on the environmental conditions across much of the site.

Sub-soils in wetland areas with shallow peat are dominated by lacustrine and shell marl which exerts a more alkaline influence on water quality. The presence of a drainage ditch that runs along most northerly section of the site supports Black Bog Rush. This species is an indicator of alkaline ground-water influence and potential rich fen development in the future. Areas of deep residual bare peat in the former production area currently have no significant ecological indicators of more acidic water chemistry present (*Sphagnum* or frequent Heather).

The north-eastern section (Coolumper) is developing a mosaic of pioneer poor fen, wetland communities and some scrub on high fields. Significant areas of open water support typical emergent pioneer vegetation communities. There is good cover of establishing Reedbeds dominated primarily by the community category '*Phragmites australis* community' (pPhrag) and to a lesser extent '*Typha* community' (pTyp). Poor fen/emergent communities occur along the margins of the open water bodies in shallower water, and include communities such as '*Carex rostrata* community' (pRos), pioneer '*Triglochin palustris* community' (pTrig), '*Typha* community' (pTyp) and pioneer '*Eriophorum angustifolium* community (poor fen)' (pEang). Pumping has ceased in this catchment.

The high fields that occur in series through these wetlands are vegetating with emergent '*Betula*-dominated community' (eBir), 'Pioneer *Juncus effusus* community' (pJeff) and 'Pioneer *Eriophorum angustifolium* community' (poor fen) (pEang), see representative photo below.

Within the north-western lobe and the south-western lobes of the bog, there are still extensive areas of bare peat. The north western lobe of the bog contains an area of residual milled deep peat (note the redder appearance in the aerial imagery). This area was previously in milled peat production for a short period and it had re-vegetated with some Heather. Post rehabilitation, this area now consists mainly of bare peat due to the creation of cell bunding.

Pioneer fen communities are beginning to colonise bare peat with community categories including 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang), 'Pioneer *Triglochin palustris* community' (pTrig) and 'Pioneer *Juncus effusus* community' (pJeff). Areas of open water occur in the NE corners of these lobes, with emergent communities including the categories '*Typha* community' (pTyp), '*Carex rostrata* community' (pRos), 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang) and 'Pioneer *Triglochin palustris* community' (pTrig).

It is too soon for habitats at Clooniff to reflect post rehabilitation change or succession. Some initial rewetting and new pioneer wetlands have been noted post the implementation of the EDRRS measures, including ceasing pumping, and environmental conditions across the site have changed significantly, meaning that initial wetland development will now be accelerated. These measures will result in a the develop of wetland communities similar to those within the east of the bog (Coolumper).

In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site.

Figure 2.2.3 Example of bare peat dominated cutover bog .

Figure 2.2.4 Establishing *Eriophorum angustifolium* and scattered Birch.

Figure 2.2.5 Clooniff (Coolumper) supports large areas of recolonising bare peat .

Figure 2.2.6 Eriophorum angustifolium beginning to establish in bare peat dominated cutover bog.

Vegetation Quadrats

No vegetation quadrats were scoped for inclusion in annual Monitoring and Verification at Clooniff.

Winter Birds – Monitoring YR1

Method

Fixed counts, following I-WeBS methods, were used to count wintering waterfowl at Clooniff over the winter period 2021/22. A total of four counts were undertaken, covering the period December to March inclusive. All surveys were undertaken during optimal weather conditions. The survey results for each count are provided in Table 2.2.1 below.

Constraints

Extensive wetlands occur at Clooniff bog. However, some parts of these can be difficult to survey due to the linear nature of some old high production fields that developed scrub, as well as the extensive reedbeds. As these features can provide shelter for some wintering wildfowl and waders, it is likely that some species have been under recorded, in particular Snipe for example.

Results – Species Richness

A total of 18 water bird species were recorded across all four surveys. Although Sandwich Tern is known to winter in small numbers in Ireland, those recorded during the March visit are likely to be on passage; returning from their wintering grounds in southern Europe and Africa to breed in Ireland. Snipe, Curlew, Lapwing and Wigeon are all BoCCI Red listed species (Gilbert *et al.* 2021). Ten Amber listed species were recorded, namely Teal, Whooper Swan, Little Egret, Wigeon, Greylag Goose, Tufted Duck, Great Crested Grebe, Sandwich Tern and Cormorant.

Results – Abundance

Teal, Mallard, Wigeon and Whooper Swan were recorded throughout the core winter months, indicating that this site is likely to regularly support these species. Constant numbers of Greylag goose were recorded but never exceeded 7 individuals, and the species is known to occur at this site all year round, likely a feral population. The threshold for National Importance for this species is 35 individuals.

Tufted Duck, Curlew, Lapwing, Little Grebe, Ringed Plover and Water Rail were each recorded in low numbers and often on only one survey date. This suggests that these species are likely to use the site intermittently during the winter months or in low numbers. Whooper swan was recorded during all visits with a peak count of 161 in December 2021. This indicates that the species uses the extensive wetlands within the east of Clooniff during the core winter months, while likely also foraging in the wider landscape.

The total counts for each visit across the winter period is presented in Table 2.2.1. It is clear that Clooniff is only used intermittently by some wintering waterfowl species while other species occur throughout the core winter months. However, given the nature of the wetland occurring at Clooniff, often difficult to survey due to the extensive nature of the linear strips of established scrub on old high production fields and established reedbeds, it is likely that some species have been under recorded.

Results – Habitat Associations

Most of the wintering wildfowl records were associated with the extensive wetland in the east of the bog (Coolumper). This, the largest wetland, was regularly used by duck and swan species as and it is likely that the established reedbeds and associated aquatic vegetation likely support greater invertebrate and vegetative feeding opportunities. In addition, the larger wetland and open water provide greater protection from predators. Snipe was found to associate more with vegetated drains at the bog or wetland margins. However, this also likely reflects the species propensity to flush from such habitats when approached during the survey.

Discussion

Overall species richness and abundance reflects the current baseline bog condition, with some pioneer wetland development and much of the remaining site still dominated by bare peat. Species richness is considered high. The lack of established aquatic and marginal vegetation therefore offers limited foraging opportunities for many species of water bird. However, the large open waterbodies do provide suitable roosting locations for wintering water birds. Over time, as supporting wetland vegetation develops at Clooniff, it is expected that it may also become a refugium for an increasing number of wintering wildfowl species such as those recorded during the 2021-22 winter months. Post rehabilitation and associated revegetation, Clooniff may contribute to further habitat for a variety of wintering bird species of conservation concern occurring in the wider landscape and support conservation objectives for nearby European Sites such as the Middle Shannon Callows SPA, which is designated for species such as Whooper Swan, and '*Wetlands and Waterbirds'*. No significant change

in wintering bird species richness and abundance can be attributed to the rehabilitation so far at Clooniff, but rehabilitation measures have consolidated conditions for wetland habitat to continue to establish to support wintering bird species.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation under the current scheme on assemblages of wintering birds.

Table 2.2.1 Winter 2021/22 – Monitoring YR1 I-WeBS Survey Results

Species	BoCCI STATUS	DEC	JAN	FEB	MAR	Mean	Maximum
MS Mute Swan *Cygnus olor*	Amber	0	0	0	2	0	2
T. Teal *Anas crecca*	Amber	10	156	102	0	89.3	156
WA Water Rail *Rallus aquaticus*	Amber	0	0	0	1	0	1
WS Whooper Swan *Cygnus cygnus*	Amber	161	45	50	41	74.2	161
LE Little Grebe *Tachybaptus ruficollis*	Amber	2	0	0	3	0	2
GJ Greylag Goose *Anser anser*	Amber	7	6	6	0	6.3	7
TU Tufted Duck *Aythya fuligula*	Amber	0	5	0	1	3	5
GG Great Crested *Grebe Podiceps cristatus*	Amber	0	0	0	6	0	6
TE Sandwich Tern *Sterna sandvicensis*	Amber	0	0	0	24	0	24
CA Cormorant *Phalacrocorax carbo*	Amber	0	0	0	1	0	1
H. Grey Heron *Ardea cinerea*	Green	0	2	2	1	1.6	2
RP Ringed Plover *Charadrius hiaticula*	Green	0	0	0	14	0	14
MA Mallard *Anas platyrhynchos*	Green	0	4	68	38	36.6	68
JS Jack Snipe *Lymnocryptes minimus*	Green	0	0	2	0	0	2
SN Snipe *Gallinago gallinago*	Red	13	0	0	1	7	13
L. Lapwing *Vanellus vanellus*	Red	0	0	0	3	0	3
WN Wigeon *Anas penelope*	Red	12	0	28	2	14	28
CU Curlew *Numenius arquata*	Red	0	0	0	1	0	1

Breeding Birds – Monitoring YR1

Methods

At Clooniff, two 500 metre transects were selected to provide a representative sample of the breeding bird community. Each transect was placed along an existing headland or rail line corridor for ease of use, but also because these locations will continue to be accessible post rehabilitation, allowing the same route to be repeated. Two visits in the period April to June of 2022 were carried out. See the Appendix C2 figure titled '*Clooniff Bog Ecology Transects'* for transect locations.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, headlands or rail lines associated with former peat extraction. Due to their location, sampling results may include species which utilise the areas adjacent to transect routes i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10.00-11.00am). CBS recommended timings are early morning, no later than 9.00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. The timing of some visits may have exceeded the CBS recommended period for surveying but were complete by 11.00am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 47 no. species were recorded, see Table 2.2.2. This included five BoCCI (Gilbert *et al.* 2021) Red listed species, Kestrel, Black-headed Gull, Lapwing, Meadow Pipit and Swift. Eleven BoCCI Amber listed species namely, Goldcrest, Grasshopper Warbler, Greylag Goose, Lesser Black-backed Gull, Little Grebe, Linnet, Mallard, Skylark, Swallow, Water Rail and Willow Warbler. Remaining species were all Green listed apart from Pheasant which is not assigned a BoCCI status.

Results – Annual Relative Abundance

Annual Relative Abundance (ARA) is presented as the maximum count per species per visit (Early or Late) or as the maximum count for the period April to June inclusive, see Table 2.2.2. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 10 individuals were recorded for 10 species, Grey Heron, Robin, Woodpigeon, Chiffchaff, Blackcap, Mallard, Blackbird, Chaffinch, Wren and Willow Warbler. All remaining species were recorded in low numbers (typically less than 5). Overall abundance was highest for Willow Warbler with a maximum of 57 individuals recorded in the period May to June. The species with the highest relative abundance associating with cutover habitats was Wren (n=28).

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Twenty-seven species associated with OPEN habitats, nineteen species associated with NON-OPEN habitats, and one species associated with both were recorded see Table 2.2.2.

Results – Colonial Species

No colonies were recorded.

Discussion

It is notable that the five Red listed species recorded, Kestrel, Black-headed Gull, Lapwing, Meadow Pipit and Swift are associated with open habitats targeted for rehabilitation in the form of rewetting, and would be expected to gain from many of the measures implemented (wetland creation and fertiliser application to high fields for example). The Green listed species, Wren associates with drier

open & non open habitats, and had the second highest relative abundance overall (n=28). Overall, the total number of species either Red or Amber listed was 16.

Regarding wading species, breeding is considered likely for Lapwing, Ringed Plover and Common Sandpiper in 2022, with the Coolumper lobe particularly important for these species. All three species have been recorded at Coolumper during both the 2020 and 2021 breeding season (April-June). Other water bird species noted previously during the breeding period include Great Crested Grebe, Mute Swan, Redshank and Snipe.

In general, the abundance estimates reflect the expansive area of wetland habitats currently present at Clooniff, as well as the associated established marginal habitats i.e. scrub, remnant bog and woodland. In time, the extensive areas of bare peat within the Clooniff bog boundary will provide more suitable habitat for many species. Regarding habitat associations, over 51% of species recorded are more associated with open habitats. Open habitat species comprise a higher proportion of Red and Amber listed species (14 no. in total), with only two Amber species associated with non-open habitats (Goldcrest, and Willow Warbler). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case. Further analysis on trends in the ratio or relative abundance of these species over time following rehabilitation would be beneficial.

In conclusion, the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds both at Clooniff and across the EDRRS scheme. In addition, the occurrence at Clooniff of many of the species described here is notable given the proximity of the adjacent European Site (the Middle Shannon Callows SPA) which includes '*Wetlands and Waterbirds',* along with species such as Lapwing, amongst its Special Conservation Interests. In time parts of Clooniff (notably Coolumper) may become an important supporting site for SCI species of this SPA. No significant change in breeding bird species richness and abundance can be attributed to the rehabilitation so far at Clooniff, but rehabilitation measures have consolidated conditions for wetland habitat and other habitat to continue to establish to support breeding bird species.

Table 2.2.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	19
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	18
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	2
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	3
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	2
BZ Buzzard *Buteo buteo*	Green	OPEN	2
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	12
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	19
CK Cuckoo *Cuculus canorus*	Green	OPEN	4
CS Common Sandpiper *Actitis hypoleucos*	Green	OPEN	3
D. Dunnock *Prunella modularis*	Green	NON-OPEN	2
GC Goldcrest *Regulus regulus*	Amber	NON-OPEN	2
GH Grasshopper Warbler *Locustella naevia*	Amber	OPEN	1
GJ Greylag goose *Anser anser*	Amber	OPEN	1
GO Goldfinch *Carduelis carduelis*	Green	OPEN	2

SPECIES	BOCCI STATUS	HABITAT ASSOCIATION	ARA
GR Greenfinch *Carduelis chloris*	Green	NON-OPEN	4
GT Great Tit *Parus major*	Green	NON-OPEN	3
H. Grey Heron *Ardea cinerea*	Green	OPEN	10
K. Kestrel *Falco tinnunculus*	Red	OPEN	3
L. Lapwing *Vanellus vanellus*	Red	OPEN	5
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	1
LG Little Grebe *Tachybaptus ruficollis*	Amber	OPEN	8
LI Linnet *Carduelis cannabina*	Amber	OPEN	8
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	5
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	1
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	1
MA Mallard *Anas platyrhynchos*	Amber	OPEN	19
MH Moorhen *Gallinula chloropus*	Green	OPEN	2
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	7
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	2
PW Pied Wagtail *Motacilla alba*	Green	OPEN	3
R. Robin *Erithacus rubecula*	Green	NON-OPEN	10
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	3
RO Rook *Corvus frugilegus*	Green	NON-OPEN	1
RP Ringed Plover *Charadrius hiaticula*	Green	OPEN	1
S. Skylark *Alauda arvensis*	Amber	OPEN	3
SC Stonechat *Saxicola rubicola*	Green	OPEN	2
SI Swift *Apus apus*	Red	OPEN	2
SL Swallow *Hirundo rustica*	Amber	OPEN	2
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	3
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	3
WA Water Rail *Rallus aquaticus*	Amber	OPEN	2
WH Whitethroat *Sylvia communis*	Green	OPEN	3
WM Whimbrel *Numenius phaeopus*	Green	OPEN	1
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	10
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	28
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	57

Pollinators

Methods

The transect at Clooniff is 1km in length. All surveys were completed between 11:55 and 15:00hrs, when the temperature was at least 16°C and during good weather conditions. See the figure in Appendix C2 titled '*Clooniff Bog Ecology Transects'* for transect locations. The study period for Year 1 was May 2022 to September 2022.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results- Species Richness

A total of seven species of butterfly were recorded namely, Green-veined White, Large White, Meadow Brown, Orange Tip, Ringlet, Small Copper and Small Tortoiseshell. In addition to butterflies, Buff tailed Bumblebee (n = 1), Bombus sp. (n = 5), Four Spotted Chaser (n = 23), Large Red Damselfly (n = 1), Common Darter (n = 4), Black-tailed Skimmer (n = 4) were also recorded during the surveys.

Results- Abundance

Small Tortoiseshell occurred in the highest abundance (24 overall), with maximum abundances recorded during the August survey. The highest abundance overall per month was recorded in August. No butterfly species were recorded during the surveys in June.

Results- Habitat Associations

The majority of the transect crosses bare peat, with poorly developed vegetation present. In general, little or no pollinator activity was clearly associated with bare peat or recently rehabilitated bare peat areas. Species recorded on bare peat sections of the transect were primarily traversing the transect to nearby vegetated drains, as insufficient vegetation is present on the transect to attract feeding pollinators. A higher proportion of pollinators were encountered at the beginning of the transect (the northern extent) which passes through the vegetated headland.

Discussion

The baseline scenario for Clooniff still reflects habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators. It is likely that species richness and abundance will increase in future surveys along the transect route when the rehabilitated area begins to revegetate.

Table 2.2.3: 2022 – Monitoring YR1 Pollinator Survey Results

Species	**May**	**June**	**July**	**August**	**September**	**Total**
Green-veined White *Pieris napi*	3	0	5	0	2	10
Large White *Pieris brassicae*	0	0	1	0	0	1
Meadow Brown *Maniola jurtina*	0	0	1	0	0	1
Orange Tip *Anthocharis cardamines*	1	0	4	0	0	5
Ringlet *Aphantopus hyperantus*	0	0	2	0	0	2
Small Copper *Lycaena phlaeas*	0	0	0	1	1	2
Small Tortoiseshell *Aglais urticae*	0	0	0	19	5	24
Total	4	0	13	20	8	45

2.2.3 Surface water quality

Clooniff bog surface water outlets discharge to the Upper Shannon water body IE_SH_26 S021800, via several feeder streams, including the Hillsend, Ballydangan and Moore streams, and direct to the Shannon. Clooniff bog has a total of eight treated water outlets with four of these outlets monitored as part of EDRRS (SW 51, 52, 53 & 60). The location of these outlets are shown on Drawing No. DR-22-07-32 in Appendix C.

Analysis of available monitoring over the past 5 years of the IPC licence environmental monitoring programme, indicate that relevant parameters like Suspended Solids had an average of 11 mg/l, with Ammonia averaging 0.61 mg/l, as per results below.

Table 2.2.4: Clooniff Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS mg/l	TS mg/l	Ammonia mg/l	TP mg/l	COD mg/l	Colour
Clooniff	SW-54	Q3 20	8.2	7	185	0.028	0.05	97	440
Clooniff	SW-58	Q2 20	6.9	5	166	0.043	<0.05	82	296
Clooniff	SW-58	Q1 19	6.5	12	222	<0.02	0.11	138	264
Clooniff	SW-54	Q2 19	6.2	<5	150	<0.02	0.06	57	353
Clooniff	SW-54	Q1 18	6.2	5	136	0.56	0.05	79	253
Clooniff	SW-54	Q1 17	6.5	5	106	0.43	0.05	89	279
Clooniff	SW-58	Q1 17	6.7	5	70	0.07	0.05	65	285
Clooniff	SW-51	Q2 17	7.4	17	174	2.5	0.05	110	252
Clooniff	SW-52	Q2 17	7.4	10	230	1.2	0.05	106	191
Clooniff	SW-53	Q2 17	7.1	5	130	0.02	0.05	97	359
Clooniff	SW-57	Q2 17	8.5	35	196	0.04	0.05	93	96
Clooniff	SW-61	Q2 17	7.9	5	336	0.06	0.05	33	64

Monthly EDRRS baseline monitoring commenced in August 2020, which gave 20 sampling events for this report, up to June 2022. During this monitoring period, suspended solids showed an average of 5.8mg/l from outlet SW51, 5.7mg/l from SW52, 4.4mg/l from SW53 and 5.2mg/l from SW 60. Similarly, Ammonia had an average of 0.257 mg/l from all outlets which is less than when the bog was in active production and as per graphs in Appendix C3 are primarily trending downwards over the period in question.

Rehabilitation commenced in April 2022, with overall trends remained flat for suspended solids during the period with no obvious clear relationship between rainfall and concentration of run-off at this location, other than for ammonia which showed a reducing concentration in 75% of the monitored outlets. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.82.

Surface water monitoring for the period and associate graphs are in Appendix C3.

2.2.4 Archaeology

This bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures.

There was one archaeological site in Clooniff Bog RMP RO055-005 identified during the Archaeological Impact Assessment which was avoided by the rehabilitation works and protected with a 20m buffer.

2.2.5 Aerial Imagery / LiDAR

Clooniff Bog aerial images available prior to the commencement of the rehabilitation dates from April 2020 and LiDAR was flown in December 2020 prior to the commencement of rehabilitation. As rehabilitation of Clooniff did not commence until April 2022, this bog was not included in the Year 1 LiDAR and aerial imagery survey.

2.3 Garryduff Bog

Garryduff Bog is located approximately 1 km south of Shannonbridge in Co. Galway and the area of the bog is 972 hectares. The River Suck flows along the northern boundary and meets the River Shannon, which flows along the eastern boundary. Garryduff Bog was from 1968 until industrial peat production ceased in 2019. Further information on the bog is available in the Garryduff Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Garryduff Bog commenced in July 2021 and this rehabilitation was 96% complete at the end June 2022.

2.3.1 Hydrological monitoring

Hydrological monitoring is ongoing at Garryduff bog. A total of 20 Phreatic wells have been installed, where 9 Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. BNM-DR-22-14-32 in Appendix D0. A total of four monitoring visits have been carried out to date at Garryduff bog as outlined in Appendix D1 - Garryduff Bog - Hydrological Monitoring, with manual dipping completed in May 2021, Aug 2021, January 2022, and August 2022. Monitoring will be ongoing at Garryduff bog over the next three years (2023, 2024, 2025). Garryduff is a pumped site and as pumping is reduced there will be large areas of surface water and wetland vegetation across the site. It is important to acknowledge the progress of works at Garryduff Bog, several key drainage features that would have an impact on ground water levels have yet to be completed on Garryduff Bog.

A summary of manual readings is provided in Appendix D1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were higher across most monitoring wells in Summer 2022 than Summer 2021. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the different in weather conditions leading up to the monitoring taking place. A review of logger data for a small number of wells indicates that water levels have increased significantly in some areas following the implementation of rehabilitation

measures. In the case of monitoring well GD_014s, there has been a significant increase in the water table height. This increase occurs rapidly after the implementation of rehabilitation measures (WLT4) in autumn 2021, with water levels increasing towards the ground surface, before rising further during spring 2022 (to a maximum of 0.38m above ground level). During the summer months water levels remain between 02.-0.3m above ground surface at this monitoring point. It is important to note that this monitoring well is located in a low-lying area of Garryduff Bog, and despite water levels potentially being too high at this specific location, the data suggests ideal water levels for the surrounding areas which would be between 0-0.1m above ground surface during summer months. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

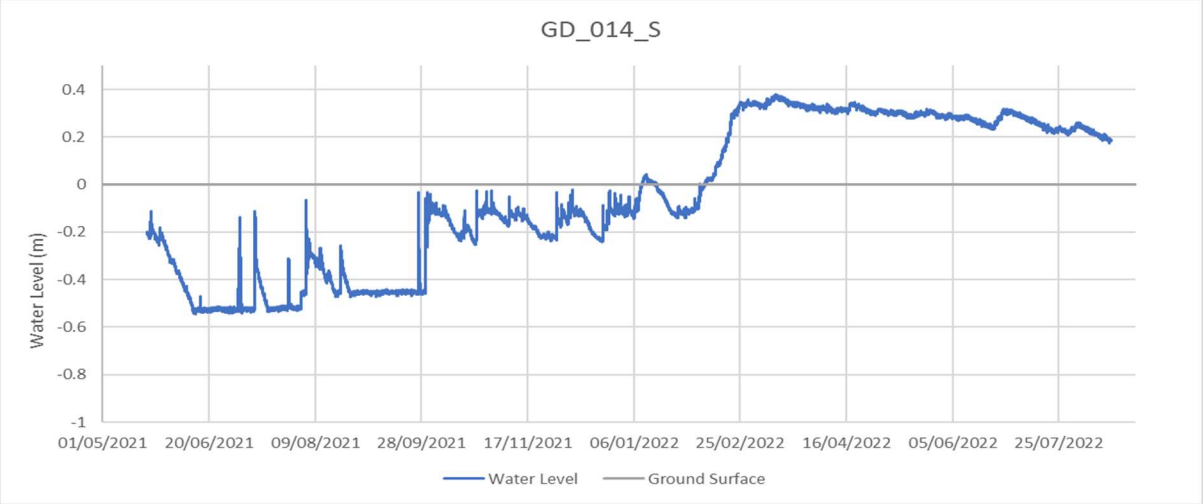

Figure 2.3.1: Hydrograph for monitoring well GD_014s

2.3.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Garryduff Bog during summer 2022.

Constraints

At the time of survey some areas of bare peat in the western section and the south-eastern extent of Garryduff had been rehabilitated to form bunded cells or wetland areas. Many of these areas are not safe for access due to standing water or soft conditions and have be avoided. However, this is not thought to have affected survey results however as there are still high fields present which can be used for access and these areas are at present entirely bare peat with little to no vegetation present.

Results

Garryduff is large bog (970 ha) in Co. Galway that has is now mostly cutaway. The entire bog is bisected by a railway line oriented north west to south east, following the old route of the Ballinasloe section of the Grand Canal. The River Suck flows along the northern boundary and meets the River Shannon, which flows along the eastern site boundary. The majority of the bog is cutaway and has a pumped drainage system (to be decommissioned on a gradual basis). This means that winter inundation will be a significant influence at this site. In areas of permanent water that swell seasonally, mosaics of open water and tall reed and sedge swamps have developed. As noted above a plan is in place to monitor water levels to reduce pumping and eventually naturalise water level fluctuations due to seasonal inundation.

Pioneer habitats within the rehabilitated area at Garryduff Bog generally correspond to the Fossitt habitat classification Cutover bog (PB4). The majority of the site is developing a mosaic of wetland vegetation types where the peat is shallow, there is significant sub-soil influence and where there is seasonal inundation. Habitats recorded during summer 2022 (according to the Bord na Móna classification system) include bare peat ('Bare peat (0-50% cover)' or BP), and the pioneer poor fen communities; 'Pioneer *Triglochin palustris* community' (pTrig), 'Pioneer *Juncus effusus* community' (pJeff) and 'Pioneer *Eriophorum angustifolium* community (poor fen)'(pEAng). In wetter areas, often close to temporary water cover (tOW) or permanent open water (OW) the pioneer poor fen communities appear in mosaics including emergent vegetation communities such as pioneering '*Carex rostrata* community' (pRos), '*Typha* community' (pTyp) and pioneer '*Phragmites australis* community' (pPhrag).

More extensive reedbeds consisting of '*Phragmites australis* community' (pPhrag), '*Schoenoplectus* community' (pSch) and pioneer '*Typha* Community' (pTyp) were observed in permanently submerged areas. Communities present in drier areas, for instance former high fields include 'Emergent *Betula*-dominated community' (eBir), 'Open *Betula*-dominated community' (oBir) and '*Betula-Salix* woodland '(BirWD).

A small part of the site with residual deep peat mainly composed of bare peat modified in line with rehabilitation intervention to form bunded cells. This work was completed in 2021.

It is too soon for habitats at Garryduff to reflect post rehabilitation change or vegetation/habitat succession. Extensive areas of Garryduff already have well established pioneer vegetation including Reedbeds, fen and Birch woodland/scrub. The habitats will continue to develop post rehabilitation as the implemented measures have consolidated wetland conditions across the majority of the site. Approximately 33% of Garryduff Bog remains as bare peat or open water on bare peat as this section was being used for peat extraction until relatively recently. Almost no fresh pioneering vegetation is present in this section.

Fertiliser application (to be targeted at high fields and headlands) at Garryduff has been completed. Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop close to the surface of these areas. In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Garryduff bog in June 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were noted.

Results

See Table 1 of Appendix D2 for detailed Quadrat data. Quadrat Q1 is located in an area dominated by bare peat with some recolonising vegetation, primarily comprising of sparse *Eriophorum angustifolium* and to a lesser extent *Mentha aquatica*, *Holcus lanatus* and some Betula *pubescens* saplings. Quadrat Q2 is located in an area of recolonising cutaway bog dominated by *Eriophorum angustifolium* and scattered *Betula pubescens,* and to a lesser extent *Salix cinerea,* scrub encroaching (see representative photo below). Quadrats Q3 and Q4 are located in areas dominated by bare peat, with little or no vegetation (see representative photo below). Quadrat Q5 is located in an area of recolonising cutaway bog dominated by *Eriophorum angustifolium,* with some pioneering *Betula pubescens, Salix cinerea,* Water Mint, Yorkshire Fog and Angelica.

Discussion

As with habitats the quadrats reflect the current baseline conditions following rehabilitation. Further time is required before any vegetation cover reflects the full effects of rewetting.

Figure 2.3.2 Quadrat Q2

Figure 2.3.3 Quadrat Q5

Figure 2.3.4 Quadrat Q3

Winter Birds – Monitoring YR1

Method

The study period comprised winter 2021/22. September 30 was the first count date. Weather conditions included occasional showers and light mist with moderate visibility. The second count was on November 02 (for October). Visibility was clear with a gentle north-westerly breeze and temperatures were mild. On November 11th visibility was good with 100% cloud cover and zero rain. Conditions on December 15th included rain, 100% cloud cover, and a light north-westerly wind. In January visibility was good with no wind and only occasional showers. The February count was held on March 01st and conditions were mostly clear, with no rain, and a SW F3 breeze. The final count was on March 24th and conditions were good with no rain or cloud and a light breeze. Across all count's, surveys were undertaken between the period 09:45am to 04:00pm.

Constraints

No constraints were noted.

Results – Species Richness

A total of thirteen water bird species were recorded across all surveys. Three of these were BOCCI (Gilbert *et al.* 2021) Red listed species namely Golden Plover, Snipe and Lapwing. Six Amber listed species were recorded namely Greenland White-Fronted Goose, Mallard, Teal, Mute Swan, Whooper Swan and Cormorant.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.3.1 and was highest for Golden Plover (n=70), however this was strongly influenced by a peak of 350 recorded in November of 2021. Mean abundance was second highest for Whooper Swan (n=63). A peak of 271 was noted for this species in February of 2022 and the species was present on six of seven counts. Lapwing and Teal had average abundances of 14 and 12 respectively. Lapwing was only recorded on one count, Teal on two. Average abundance for the remaining species was low at <10.

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Garryduff Bog. A flock of 70 Lapwing recorded in January were flying near the boundary of the bog and may be more associated with the nearby River Suck and River Shannon. A flock of 350 Golden plover in November were also in

the air near the northern boundary and were not observed on the bog. Greenland White-Fronted Goose, on the one occasion it was recorded, was directly associating with habitats on site, which is notable given its declining status.

Discussion

Overall species richness and abundance is considered medium during the period studied, given the size of Garryduff and its proximity to the River Shannon, and counts from previous surveys. The notable exception during the period studied is perhaps Whooper Swan, with a maximum count of >270 birds. This is above the 1% National Threshold for wintering Whooper Swan (150 – see Burke *et al.* 2018a). In the past Garryduff has similarly held Nationally Important numbers of this species (Lewis *et al.* 2019). During the current period, this threshold was exceeded on only one occasion and outside of this numbers remained low (<50). It is noted that pumping was ongoing during much of the study period. Pumps are only turned off once rehabilitation is complete, which was not the case over the winter of 2021/22, resulting in quite a dry site overall. It is expected that once post - rehabilitation water levels reach equilibrium; numbers of this species may be consistently higher at Garryduff during future winter periods.

The other notable occurrence was that of Greenland White-fronted Goose, (a wintering species undergoing chronic decline in Ireland) albeit in low numbers and on only one occasion (the All-Ireland Threshold is 100 birds). Historically this species would have utilised areas adjacent to the River Shannon south of Ballinasloe, including to the west of Garryduff at Lismanny, and areas along the Shannon between Shannonbridge and Athlone. Usage is thought to have generally declined since the early 2000's but irregular use is not ruled out. Some Greenland White-fronted Geese were also recorded at the adjacent Kilmacshane Bog over the winter 2021/22 period. It is notable that rehabilitation at Garryduff and other bogs nearby may provide habitat for this species in this area.

Nine species recorded were of Red or Amber status. In the context of two adjacent European Sites (the River Suck Callows SPA and Mid Shannon Callows SPA), both of which have Whooper Swan, Golden Plover, Lapwing and '*Wetland and Waterbirds'* listed as special conservation interests, a post-rehabilitation Garryduff may contribute to further habitat for SCI species and support the conservation objectives for these European Sites. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation under the current scheme on assemblages of wintering birds at Garryduff Bog. No significant change in wintering bird species richness and abundance can be attributed to the rehabilitation so far at Garryduff, but rehabilitation measures have consolidated conditions for wetland habitat to continue to establish to support wintering bird species.

Table 2.3.1 Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	Mean	Max
CA Cormorant *Phalacrocorax carbo*	Amber	0	0	0	0	0	3	0	3	3
GJ Greylag Goose *Anser anser*	Green	0	0	0	0	8	16	3	6	16

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	Mean	Max
GP Golden Plover *Pluvialis apricaria*	Red	0	0	350	0	0	60	0	70	350
H. Grey Heron *Ardea cinerea*	Green	1	3	1	0	0	4	0	4	4
L. Lapwing *Vanellus vanellus*	Red	0	0	0	0	70	0	0	14	70
LG Little Grebe *Tachybaptus ruficollis*	Green	0	0	0	0	1	0	0	2	2
MA Mallard *Anas platyrhynchos*	Amber	0	3	0	0	6	0	0	4	6
MS Mute Swan *Cygnus olor*	Amber	0	0	0	3	0	4	4	3	4
NW Greenland White-Fronted Goose *A.a. flavirostris*	Amber	0	0	0	5	0	0	0	3	5
SN Snipe *Gallinago gallinago*	Red	0	0	0	0	0	2	0	2	2
T. Teal *Anas crecca*	Amber	0	0	0	5	0	54	0	12	54
WA. Water Rail *Rallus aquaticus*	Green	1	0	0	0	0	0	0	2	2
WS Whooper Swan *Cygnus cygnus*	Amber	0	10	17	21	48	271	40	63	271

Breeding Birds – Monitoring YR1

Methods

In 2022, an early (April to mid-May) and late (mid-May to late June) season visit was conducted. The early season visit was carried out on May 11th, 2022 and covered the period 06:50am to 09:52am. Conditions were amenable to recording birds with medium to low cloud cover, light wind and zero rain. Visibility was good. The late season visit took place on June 07th, 2022 and covered the period 08:26am to 11:28am. Conditions were amenable with no rain. Cloud cover was medium to low and winds were light, with good visibility. See the figure in Appendix D2 titled 'Garryduff Bog Ecology Transects' for transect locations.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to rail lines i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am-11:00am). CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. The timing of the late season visits in June exceeded the CBS recommended period for surveying but were complete by 11:28am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 39 no. species were recorded, see Table 2.3.2. This included four BOCCI (Gilbert *et al.* 2021) Red listed species Black-headed Gull, Lapwing, Meadow Pipit and Snipe along with 13 no. BOCCI Amber listed species namely Common Sandpiper, Goldcrest, Lesser Black-backed gull, Linnet, Mallard, Mute Swan, Ringed Plover, Skylark, Swallow, Sand Martin, Wheatear, Whooper Swan and Willow Warbler. Remaining species were all Green listed apart from Pheasant which is not assigned a BOCCI status.

Although a bespoke breeding waders survey was not undertaken, data on wading species recorded is herein presented in line with an interpretation following the O'Brien and Smith (1992) method for censusing lowland breeding wader populations. This is interpreted as a minimum estimate for Garryduff and on this basis 1-2 pairs of Lapwing, 1 pair of Ringed Plover, 1 pair of Common Sandpiper and 22 pairs of Snipe bred onsite in 2022.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species per visit (E or L) or as the maximum count for the period April to June inclusive, see Table 2.3.2. This allows for future comparison with CBS trends which takes the same approach to index species. Maximum counts of greater than 20 individuals were recorded for eight species, Snipe, Reed Bunting, Black-headed Gull, Redpoll, Skylark, Willow Warbler, Meadow Pipit, and Sand Martin.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Fifteen species considered associated with NON-OPEN

habitats were recorded and twenty-three species associated with OPEN habitats were recorded see Table 2.3.2. One species recorded associates with both habitat categories.

Results – Colonial Species

A small colony of Sand Martin comprising 11 active nest holes in peat was recorded along transect 4 in an existing cutaway face bank.

Discussion

It is notable that the three Red listed species recorded, Black-headed Gull, Lapwing and Snipe are associated with open habitats targeted for rehabilitation in the form of rewetting and would be expected to gain from measures intended to effectively create wetlands. The rapid colonisation by breeding Black-headed Gull post rewetting is of note. The final Red listed species, Meadow Pipit associates with drier open habitats and had the second highest relative abundance overall. Thirteen Amber species were recorded but two of these, Wheatear and Whooper Swan can be attributed to passage or long staying wintering birds, respectively. Overall, the total number of species either Red or Amber listed was 18, suggesting the importance of Garryduff for species of conservation concern in one form or other, either foraging or breeding or for use as a refugium. [redacted]

Breeding waders were dominated by Snipe (22 pairs minimum). Lapwing breeding numbers may be even higher than the minimum 1-2 pairs estimated as a total of 8 was recorded in June (this is outside the period relevant for O'Brien and Smith analysis). Regarding Snipe the numbers breeding at Garryduff are considered notable. For comparison, in the Baltic region breeding Common Snipe were recorded in flooded former peat-extraction areas, with vegetation resembling transition mires; at 'rather high' breeding densities of up to 8—11 pairs/100 ha (Švazas *et al.* 2002). It has been noted in the Irish context (Hudson and Tierney, 2002) that Snipe distributions fluctuate by the degrees of wetness of an area from year to year, in this context, further evaluation year on year as EDRRS monitoring progresses (aligned with the phase out of pumping) should establish the quality of impact of rewetting at Garryduff on this species.

Relative abundance was highest in 2022 for eight species. Variation between these and other published data on raised bog breeding bird communities may reflect the differing habitat mosaics typically found on cutaway in contrast to the more homogenous raised bog habitats previously studied. Sand Martin, the species with the highest relative abundance in 2022, breed at many Bord na Móna cutover sites in either exposed face bank or suitable drains and the absence of further colonies on transects does not preclude nesting colonies or multiple individual nesting burrows elsewhere. Sand Martin have been observed nesting singularly in the 'eyes' of the larger drains at Garryduff, and it is likely that this trend has continued across the site. The size of Garryduff (ca. 900 Ha) is also a likely factor in terms of sheer availability of foraging and nesting habitat.

Regarding habitat associations 62% of species recorded are more associated with open habitats. Many of these species frequently visit open areas of cutaway to forage. Open habitat species comprise a higher proportion of Red and Amber listed species (15 no. in total), with only two either Red or Amber species associated with non-open habitats (Goldcrest and Willow Warbler). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case. Further analysis on trends in the ratio or relative abundance of these species over time following rehabilitation would be beneficial.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway bogs and establishes the potential importance of Garryduff in respect of breeding birds of conservation concern, notably wading species. In the future, Garryduff may become an important supporting refugium for nearby European Sites, notably the adjacent Middle Shannon Callows SPA and the River Suck Callows SPA. No significant change in breeding bird species richness and abundance can be definitively attributed to the rehabilitation so far at Garryduff, but on a cautionary basis, we suggest the colonisation by breeding Black-headed Gulls, and numbers of breeding Snipe are positive and could reflect re-wetting. Further analysis over time is recommended. Nonetheless. rehabilitation measures have consolidated conditions for wetland habitat and other habitat to continue to establish to support breeding bird species.

Table 2.3.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	15
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	26
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	8
CK Cuckoo *Cuculus canorus*	Green	OPEN	8
CS Common Sandpiper *Actitis hypoleucos*	Amber	OPEN	2
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
GC Goldcrest *Regulus regulus*	Amber	NON-OPEN	2
H. Grey Heron *Ardea cinerea*	Green	OPEN	7
HC Hooded Crow *Corvus cornix*	Green	OPEN	11
J. Jay *Garrulus glandarius*	Green	NON-OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	8
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	4
LG Little Grebe *Tachybaptus ruficollis*	Green	OPEN	11
LI Linnet *Carduelis cannabina*	Amber	OPEN	2
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	31
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	11
MA Mallard *Anas platyrhynchos*	Amber	OPEN	8
MG Magpie *Pica pica*	Green	NON-OPEN	2
MH Moorhen *Gallinula chloropus*	Green	OPEN	8
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	64
MS Mute Swan *Cygnus olor*	Amber	OPEN	5
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	12
R. Robin *Erithacus rubecula*	Green	NON-OPEN	5
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	24
RP Ringed Plover *Charadrius hiaticula*	Amber	OPEN	1
S. Skylark *Alauda arvensis*	Amber	OPEN	36
SC Stonechat *Saxicola rubicola*	Green	OPEN	2
SL Swallow *Hirundo rustica*	Amber	OPEN	6
SM Sand Martin *Riparia riparia*	Amber	OPEN	96

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
SN Snipe *Gallinago gallinago*	Red	OPEN	22
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	3
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	5
W. Wheatear *Oenanthe oenanthe*	Amber	OPEN	1
WH Whitethroat *Sylvia communis*	Green	NON-OPEN	6
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	4
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	10
WS Whooper Swan *Cygnus cygnus*	Amber	OPEN	2
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	46

Pollinators

No Pollinator survey was required at Garryduff bog under the agreed Monitoring and Verification scope.

2.3.3 Surface Water Quality

Garryduff bog has three treated surface water outlets, one to the Shannon Lower IE_SH_25SO12060, and two to the to the River Suck IE_SH_26S071500 catchment. Two of these outlets are monitored as part of EDRRS (SW 11 & SW 12) and these are shown on Drawing No. BNM-DR-22-14-32 in Appendix D.

Analysis of any monitoring over 3 years of the IPC licence environmental monitoring programme, when this bog was in active production, indicate that results were under the emission limit value for Suspended solids and trigger levels for ammonia and COD. Suspended Solids had an average of 4.0 mg/l, with Ammonia averaging 0.716 mg/l, as per results below.

Table 2.3.3: Garryduff Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS mg/l	TS mg/l	Ammonia mg/l	TP mg/l	COD mg/l	Colour
Garryduff	SW-11	Q3 20	8.3	3	388	0.501	<0.05	59	151
Garryduff	SW-12	Q3 20	7.8	3	415	0.779	<0.05	55	144
Garryduff	SW-13	Q3 20	8	3	487	0.196	<0.05	55	138
Garryduff	SW-11	Q3 17	7.9	5	388	1.3	0.05	47	84
Garryduff	SW-12	Q3 17	7.9	5	500	1.2	0.05	44	54
Garryduff	SW-13	Q3 17	7.9	5	436	0.32	0.05	46	100

Monthly EDRRS baseline monitoring commenced in November 2020, which gave 22 sampling events for this report, up to August 22. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 4.4 mg/l at SW11 and 7.6 mg/l at SW12.

Similarly, Ammonia had an average of .517 mg/l over the two outlets, which is less than when the bog was in active production and is trending slightly downwards. Rehabilitation commenced in July 2022 and over all trends in these two parameters remained reasonable unchanged and heading in an improving trajectory. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

The pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.82.

Surface water monitoring for the period and associate graphs are in Appendix D3.

2.3.4 Archaeology

Garryduff bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, the line of the Grand Canal (GA100-114---and GA101-007---) and a bridge (NIAH 30410003) were identified and protected with a 20m buffer zone.

2.3.5 Aerial Imagery / LiDAR

Garryduff Bog aerial images available prior to the commencement of the rehabilitation dates from April 2020 and LiDAR was flown in December 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Garryduff Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.4 Kellysgrove Bog

Kellysgrove Bog is located in east Co. Galway, just over 2km south of Ballinasloe and the area of the bog is 203 hectares. Kellysgrove Bog was drained in the 1980s in anticipation of peat production but no peat harvesting ever took place. Prior to the commencement of the rehabilitation measures, the site still retained raised bog vegetation, although it was degraded. Further information on the bog is available in the Kellysgrove Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on this bog in April 2021 and was fully completed by early September 2021.

2.4.1 Hydrological monitoring

Hydrological monitoring is ongoing at Kellysgrove bog. A total of 5 nests comprised of 5 deep wells and 5 Phreatic wells have been installed and 3 Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. BNM-DR-22-02-32 in Appendix E0. A total of three monitoring visits have been carried out to date at Kellysgrove bog as outlined in Appendix E1 - Kellysgrove Bog - Hydrological Monitoring, with manual dipping completed in July 2021, January 2022, and logger dipping in August 2022. Monitoring will be ongoing at Kellysgrove bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix E1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with

only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were higher at one monitoring well in summer 2022 than summer 2021 and equal at other wells. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The data recorded via the logger at well KG_003_S show the water level remained quite consistent throughout the monitoring period, dropping to a maximum of 20cm below ground surface during Summer 2021. Initial data from 2022 suggests water levels remain above this at all times, but this is based on an incomplete summer dataset. Results will become clearer at the next round of downloads, but the data does suggest that water levels are now typically within 10cm of the ground surface at all times. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

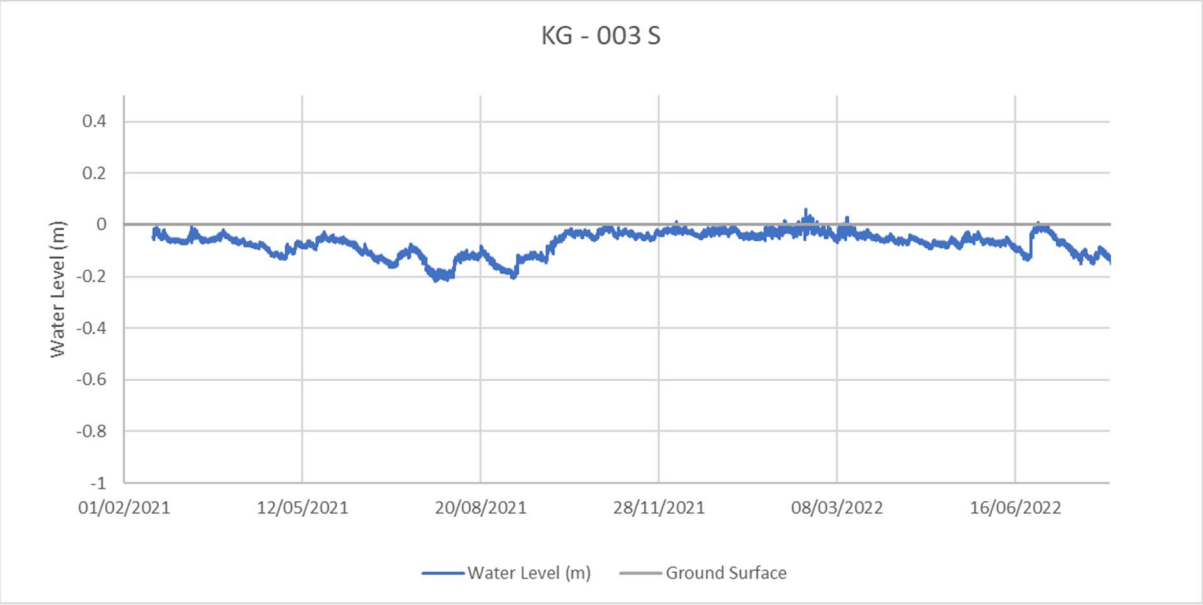

Figure 2.4.1: Hydrograph for monitoring well KG_003s

2.4.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Kellysgrove Bog during summer 2021.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Kellysgrove Bog was made up of drained raised bog (PB1) that has never been harvested for industrial peat extraction despite the high bog having been ditched in the early 1980's. The site supports the priority Annex I habitat type listed on the EU Habitats Directive; '*active raised bog*' (7110) and '*degraded raised bogs still capable of natural regeneration*' (7120). Drain-blocking was carried out in 2021.

The bog has now been re-wetted and drains generally have high water levels. Borrow pits used to source peat are generally full of water and some sections of the bog surface have surface water (< 5 cm deep) at times. Some of the drainage ditches on the high bog have started to infill with *Sphagnum* mosses and there is a small wet quaking area with abundant *Sphagnum* cover in the central part of the bog where drainage has broken down. This area comprises sub-central ecotope dominated by *Sphagnum* mosses. Some of the wettest sections contain species such as White Beak-sedge (*Rhynchospora alba*), Common Cotton-grass (*Eriophorum angustifolium*), Hares-tail Cotton-grass (*Eriophorum vaginatum*) and Great Sundew (*Drosera anglica*), which is typical of flushed (or sub-central ecotope) raised bog areas. The *Sphagnum* cover in sub-central zones is dominated by lawns of *Sphagnum cuspidatum, S. papillosum, S. capillifolium* and *S. subnitens*.

The micro-topography supports remnant hummocks of *Sphagnum fuscum* and *S. austinii.* However, such hummocks are rare, and the bog hydrology has been impacted as a result of drainage operations undertaken in the 1980's. Hollows and pools are absent although *Sphagnum* lawns occur in wetter areas of 'active bog'. The formation of *Sphagnum*-rich bog in the central part of the site is so far attributed to secondary re-wetting of the high bog due to natural break-down of drainage. Conditions are progressively drier towards much of the western section of the bog and along the bog margins where 'marginal' ecotope dominates. The site supports 'marginal', 'sub-marginal' and 'facebank' ecotopes that are typical indicators of more degraded raised bog while active areas are characterised by the presence of 'sub-central' ecotope.

The old Ballinasloe canal runs through the site separating a linear section of raised bog to the north-east from the remainder of the site. The canal itself has largely infilled. The canal vegetation is dominated by Purple Moor Grass, with large stands of Bog Myrtle.

Prior to rehabilitation Kellysgrove was already developing *Sphagnum*-rich vegetation aligned to active raised bog, in areas where drainage had broken down, indicating good prospects for future development of active raised bog post rehabilitation. Although the water levels have risen, it is too soon for vegetation at Kellysgrove to reflect post rehabilitation change. Further time is required before any significant changes in the current vegetation composition is likely to be recorded. However, subsequent surveys undertaken in 2022 have shown that the bog has become significantly wetter post rehabilitation/drain blocking (see representative drone image under vegetation quadrats, below).

Hydrological modelling pre-rehabilitation indicated that only part of the bog has the potential to develop active raised bog in relation to the overall raised bog. However, the widespread drain-blocking programme carried out in 2021 will improve the overall bog condition and improve the condition of the supporting raised bog habitat. When optimal hydrological conditions have developed on the high bog, it is expected that the area of Active Raised Bog (ARB) habitats at Kellysgrove will increase and the natural micro-topography of an active raised bog (hummocks, hollows, pools) will redevelop in time.

Figure 2.4.2 View of the typical high bog vegetation.

Figure 2.4.3 View of the old Ballinasloe Canal.

Figure 2.4.4 Kellysgrove Bog is predominantly drained raised bog.

Figure 2.4.5 Subcentral ecotope at of Kellysgrove.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Kellysgrove bog in June 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were noted.

Results

See Table 1 of Appendix E2. All quadrats were taken on the high bog (PB1) and are representative of this degraded raised bog vegetation. As shown in the quadrat data, all locations sampled contained *Sphagnum* cover, with two quadrats (Q1 & Q4) containing good *Sphagnum* cover i.e. 51-75%, Q2 containing moderate *Sphagnum* cover i.e. 26-33% and two (Q3 & Q5) low *Sphagnum* cover i.e. 04-10%. *Sphagnum capillifolium*/subsp. *rubellum* and *S. papillosum* were most commonly represented.

Discussion

As with habitats the quadrats reflect the current baseline conditions following rehabilitation. Kellysgrove bog comprises of a relatively large area of non active raised bog. As the bog was subject to historic industrial drainage, but never brought into peat production, the bog is noted to be dry in

many places. Further time is required before any significant changes in the current vegetation composition is likely to be recorded. However, subsequent surveys undertaken after the initial quadrat monitoring has shown that the bog has become significantly wetter post rehabilitation/drain blocking, see representative drone image below.

Figure 2.4.6 Quadrat Q2

Figure 2.4.7 Quadrat Q5

Figure 2.4.8 Example of significant rewetting post rehabilitation (03.06.2021).

Winter Birds

No winter bird counts were scoped in as part of Monitoring and Verification at Kellysgrove Bog.

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 1 no. transect which was visited four times in the period April to July 2022 inclusive. Breeding waders' surveys were also undertaken on the same dates and incorporated the

transect into a longer extended walking route around the bog. See the figure in Appendix E2 titled '*Kellysgrove Bog Ecology Transects'* for transect locations.

Constraints

Due to their location sampling results may occasionally include species which utilise the areas adjacent to transects but which are not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am -11:00am). CBS recommended timings are early morning, no later than 9am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. CBS visits were generally complete by 10:00am so data is considered acceptable. In respect of breeding waders the O'Brien and Smith (1992) method for censusing lowland breeding waders recommends that Snipe are not counted more than 3 hours after dawn, however in June, breeding waders surveys extended until 11:45am. Other methods such as the Reed and Fuller (1983) method for surveying waders (including Snipe) on machair allow for records between 08:30am-06:00pm BST (British Summer Time), and the Brown and Shepherd (1993) method for censusing upland breeding waders is similar. On this basis the data for Snipe in June has been analysed. It is noted that otherwise all visits were complete by approximately 10:00am. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 29 no. species were recorded, see Table 2.4.1. This included three BOCCI (Gilbert *et al.* 2021) Red listed species Meadow pipit, Snipe and Golden Plover, along with 6 no. BOCCI Amber listed species namely Linnet, Merlin, Skylark, Swallow, Sand Martin, and Willow Warbler. Remaining species (n=19) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

A bespoke breeding waders survey was undertaken in 2022, data on breeding pairs is herein presented in line with an interpretation following the O'Brien and Smith (1992) method for censusing lowland breeding wader populations. On this basis 7 no. pairs of Snipe bred at Kellysgrove in 2022. The only other wading species recorded was a flock of 45 no. Golden Plover in April, however Kellysgrove is outside the breeding range of this species in Ireland and these were either passage or late wintering birds and we exclude this species from further analysis.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species across visit #1, #2, or #3 or within the period April to June inclusive, see Table 2.4.1. This allows for future comparison with CBS trends which takes the same approach to index species. Maximum counts of greater than 40 individuals were recorded for one breeding species, Meadow Pipit (n=44). Skylark had the next highest abundance with a maximum of 16 recorded.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of raised or cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Sixteen species considered associated with NON-OPEN habitats were recorded and 12 species associated with OPEN habitats were recorded see Table 2.4.1. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were observed.

Discussion

Both Meadow pipit and Skylark dominate in terms of breeding bird abundance (Golden Plover and other species such as Rook were recorded as flyovers and do not breed within the rehabilitation extent). Wren and Willow Warbler are the next highest in abundance. This aligns with previous studies on raised bogs, in Bracken *et al.* (2008) for instance Meadow Pipit comprised 61.7% of the community proportion of raised bog species recorded, and in the same study Skylark comprised 30.2%. Wrens will breed on raised bogs see Nairn & O'Halloran (2012). In this case the occurrence of Willow Warbler is related to the transect location as it allowed nearby habitats outside of Kellysgrove to be sampled.

Breeding waders comprised Snipe only, however this is reasonably expected. The only other waders likely to occur would be Redshank and or/ Curlew. Seven pairs were noted based on observations in June. In a study of Clara Bog, Co. Offaly (modified from Wilson (1990) in Nairn & O'Halloran 2012) a density of 7.5 individuals per km^2 was found.

Regarding habitat open habitat species comprise a higher proportion of Red and Amber listed species (8 no. in total). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009) on cutaway, and it is reasonable to assume the same for raised bog. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising raised bogs subject to restoration. No significant change in breeding bird species richness and abundance can be attributed to the bog restoration so far at Kellysgrove but drain-blocking has consolidated conditions for raised bog habitat to continue to improve condition to support breeding bird species already present on site.

Table 2.4.1: 2022 – Monitoring YR1 Countryside Bird Survey Results

Species	**BOCCI 2020 - 2026 STATUS**	**HABITAT ASSOCIATION**	**ARA**
B. Blackbird *Turdus merula*	Green	NON-OPEN	4
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	3
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	4

Species	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
GP Golden Plover *Pluvialis apricaria*	Red	OPEN	46
GT Great Tit *Parus major*	Green	NON-OPEN	1
HC Hooded Crow *Corvus cornix*	Green	OPEN	4
J. Jay *Garrulus glandarius*	Green	NON-OPEN	1
LI Linnet *Carduelis cannabina*	Amber	OPEN	0
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	6
MG Magpie *Pica pica*	Green	NON-OPEN	1
ML Merlin *Falco columbarius*	Amber	OPEN	0
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	44
P. Peregrine *Falco peregrinus*	Green	OPEN	1
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	4
R. Robin *Erithacus rubecula*	Green	NON-OPEN	2
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	2
RO Rook *Corvus frugilegus*	Green	NON-OPEN	15
S. Skylark *Alauda arvensis*	Amber	OPEN	16
SC Stonechat *Saxicola rubicola*	Green	OPEN	2
SL Swallow *Hirundo rustica*	Amber	OPEN	0
SM Sand Martin *Riparia riparia*	Amber	OPEN	5
SN Snipe *Gallinago gallinago*	Red	OPEN	7
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	3
WH Whitethroat *Sylvia communis*	Green	NON-OPEN	1
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	2
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	13
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	13

Pollinators

No bespoke Pollinator surveys were scoped as part of agreed Monitoring and Verification.

Note: A total of 23 no. Large Heath *Coenonympha pamphilus* butterfly, along with Common Blue, Meadow Brown and Green Hairstreak butterflies were noted during a wader survey on June 22, 2022. Burnet Companion, a day flying moth, was also recorded.

2.4.3 Surface Water Quality

Kellysgrove bog has two surface water outlets discharging to the River Suck IE_SH_26S071500. Both outlets are monitored as part of EDRRS (KN 1 & KS 1) and are shown on Drawing No. BNM-DR-22-02-32 in Appendix E0.

While the bog was drained initially in the 1980's, Bord na Mona never produced any peat from this bog, and since then it has remained as such. As the bog was never stripped for production or became operational, it did not have any constructed outfalls or associated silt ponds and discharge points to

the local receiving water and as such would have had minimal impact on the Suck. As the old Ballinasloe Canal runs parallel to the bog, between it and the River Suck, most surface water discharges to the old disused Canal system and eventually to the Suck, when the drains were fully active.

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 23 sampling events for this report, up to July 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 2.9 mg/l at KN1 and 3.0 mg/l at KS1, Ammonia had an average of 0.127 mg/l over the two outlets. Rehabilitation commenced in April 2021 and finished in September 2021, with 10-month monitoring post rehabilitation recorded and over all trends in suspended solids remained reasonably unchanged and heading in an improving trajectory, while there was a slight rise in concentration of Ammonia.

During this period with significant drain blocking there were only some slight noticeable peaks in suspended solids towards the end of the works, but well within limits.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.94.

Surface water monitoring for the period and associate graphs are in Appendix E3.

2.4.4 Archaeology

Kellysgrove Bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, known archaeology in the rehabilitation area included a large number of archaeological finds but no sightings of monuments.

2.4.5 Aerial Imagery / LiDAR

Kellysgrove aerial images available prior to the commencement of the rehabilitation date from July 2017 and LiDAR was flown in December 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Kellysgrove Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.5 Kilmacshane Bog

Kilmacshane Bog is located in Co. Galway, on the western banks of the River Shannon approximately 1.5 km north of Banagher. The area of the bog is 1,298 hectares. Kilmacshane Bog was drained and

developed for industrial peat production in the 1960s and was in active peat production from 1968 until industrial peat production ceased in 2014. Further information on the bog is available in the Kilmacshane Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on this bog in May 2021 and was 91% complete at the end of June 2022.

2.5.1 Hydrological monitoring

Hydrological monitoring is ongoing at Kilmacshane Bog. A total of 29 Phreatic wells have been installed, and 11 Phreatic wells have been instrumented with automated loggers. In addition, 1 deep pipe well has been installed with a logger. Details of the location of these wells are shown on Drawing No. BNM-DR-22-05-32 in Appendix F0. A total of four monitoring visits have been carried out to date at Kilmacshane bog as outlined in Appendix F1 – Kilmacshane Bog - Hydrological Monitoring, with manual dipping completed in May 2021, Aug 2021, January 2022, and August 2022. Monitoring will be ongoing at Kilmacshane bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works at Kilmacshane Bog as several key drainage features that would have an impact on ground water levels have yet to be completed.

A summary of manual readings is provided in Appendix F1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates significant variation in water tables between summer 2021 and summer 2022. Water levels are notably deeper at several wells in summer 2022 than summer 2021, although all of these wells are located in the driest and most elevated parts of the site (i.e., towards the south/south-west) suggesting this difference is likely caused by the very dry conditions encountered during August 2022. In contrast, water levels are higher at several wells, particularly in low-lying parts of the site (e.g., KS_015s & KS_023s). This is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place.

The logger data from well KS_015_S shows that during summer 2021 water levels were typically within 20cm of the ground surface, before rising rapidly in winter 2021/22. During Summer 2022, water levels remained consistently higher than 2021 at this monitoring well and within 10cm of the ground surface at all times. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

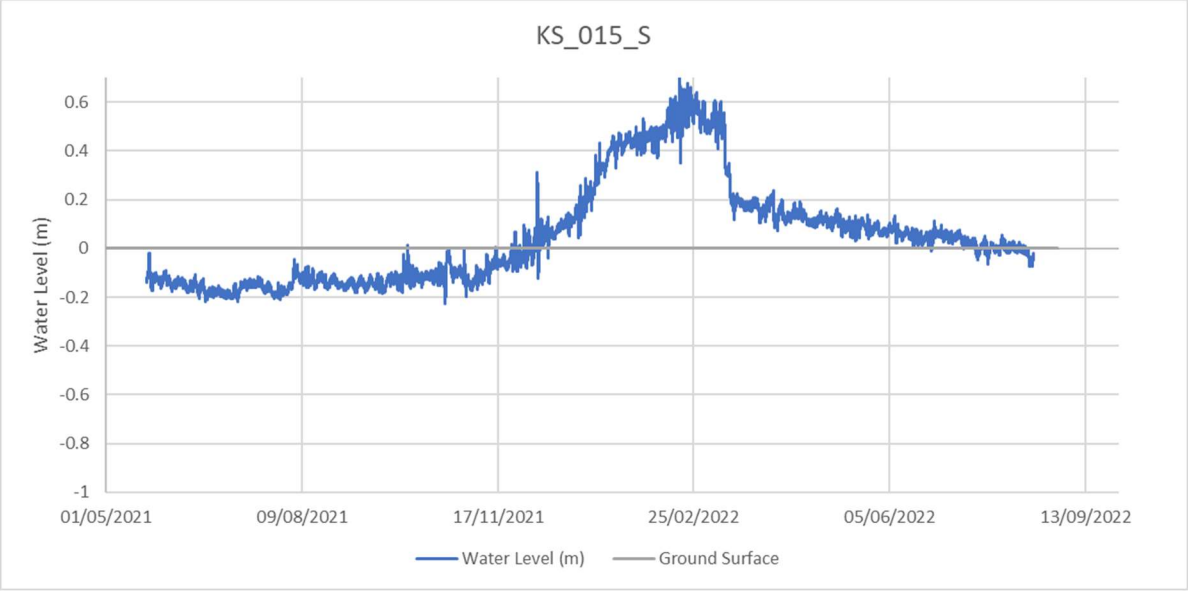

Figure 2.5.1: Hydrograph for monitoring well KS_015s

2.5.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline habitat survey of habitats at Kilmacshane Bog during summer 2022.

Constraints

At the time of survey some areas of bare peat across the extent of Kilmacshane Bog had been rehabilitated to form bunded cells or wetland areas. Many of these areas are not safe for access due to standing water or soft conditions and have to be avoided. However, this is not thought to have affected survey results however as there are still high fields present which can be used for access and these areas are at present entirely bare peat with little to no vegetation present.

Results

Kilmacshane is a large bog in Co. Galway that is nearly all cutaway. The entire bog is bisected by a railway line oriented north west to south east, following the old route of the Ballinasloe section of the Grand Canal. Kilmacshane Bog is divided into 3 distinct lobes from west to east. The western most lobe is the smallest, the central lobe is the second largest while the eastern lobe is the largest. The majority of the bog is cutaway and has a pumped drainage system. This means that winter inundation will be a significant influence at this site. In areas of permanent water that swell seasonally, mosaics of open water and tall reed and sedge swamps have developed.

Habitats within the rehabilitated area at Kilmacshane bog correspond to the Fossitt habitat classification Cutover bog (PB4). Pioneering vegetation communities have started to develop across the bog in areas that have been cutaway. In areas of permanent water that swell seasonally mosaics of open water and tall reed and sedge swamps have developed. A small part of the site has bare peat modified in line with rehabilitation intervention to form bunded cells along with previously created

field drains associated with peat extraction which are now largely blocked; this work was completed in 2021.

Communities recorded during summer 2022 included; 'Bare peat (0-50%cover)' (BP), 'Pioneer *Triglochin palustris* community' (pTrig), 'Pioneer *Juncus effusus* community' (pJeff) and 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang). In wetter areas, often close to temporary water cover or permanent open water the pioneer fen communities appear in mosaics with emergent vegetation communities such as pioneering '*Carex rostrata* community' (pRos), '*Typha* community' (pTyp) and pioneer '*Phragmites australis* community' (pPhrag).

Rudimentary rich fen communities comprising either 'Pioneer rich fen community with *Schoenus nigricans* (rudimentary rich fen)' (Pschon) or 'Pioneer *Carex viridula*/brown moss community (richfen)' (pVir) are scattered throughout the bog in areas where alkaline conditions are prevalent. More extensive reedbeds consisting of *Phragmites australis* (pPhrag), *Schoenoplectus* (pSch) and pioneer *Typha* (pTyp) vegetation were observed in permanently submerged areas. The communities 'Emergent *Betula*-dominated community' (eBir), 'Open *Betula*-dominated community' (oBir) and '*Betula*-*Salix* woodland' (BirWD) are present in drier areas, for instance former high fields.

It is too soon for habitats at Kilmacshane to reflect post rehabilitation change or succession. The majority of the site already has well established mosaic of pioneer vegetation including Reedbed, fen and rudimentary alkaline fen, along with frequent patches of shallow surface water. These habitats will continue to develop post rehabilitation. Drier parts of Kilmacshane already have establishing pioneer vegetation including Birch woodland/scrub. These habitats will continue to develop post rehabilitation as the implemented measures have consolidated wetland conditions across the majority of the site. Very little new pioneering vegetation is present in the rehabilitation extent in bare peat areas most recently used for peat extraction but there is frequent scattered patches of shallow surface water.

Fertiliser application (to be targeted at high fields and headlands) at Kilmacshane has been carried out. Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop close to the surface of these areas. In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site.

Figure 2.5.2 Bare peat and pioneer open habitats.

Figure 2.5.3 Bare peat.

Figure 2.5.4 Birch scrub on deep peat.

Figure 2.5.5 Bare peat and pioneer poor fen communities

Vegetation Quadrats

No Quadrat monitoring is included in agreed Monitoring and Verification studies in respect of Kilmacshane.

Winter Birds – Monitoring YR1

Method

IWeBS counts were carried out on six dates across the period September 2021 to February 2022 inclusive. All were conducted in good weather conditions amenable to recording water birds. Count durations spanned the period 09:00am to 04:30pm.

Constraints

No constraints were noted.

Results – Species Richness

A total of eighteen water bird species were recorded across all surveys. Six of these were BOCCI (Gilbert *et al.* 2021) Red listed species namely Black-headed Gull, Curlew, Golden Plover, Lapwing, Snipe, and Shoveler. Nine Amber listed species were recorded namely Coot, Common Sandpiper, Greylag Goose, Mallard, Mute Swan, Ringed Plover, Teal, Greenland White-Fronted Goose and Whooper Swan.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.5.1 and was highest for Whooper Swan (n=174). A peak of 377 was noted for this species in January of 2022 and birds were present on five of six counts. Average abundance was second highest for Greylag Goose (n=56) and a flock was present on five of six counts with a maximum of 98 in January of 2022. Lapwing was third highest in terms of average abundance (n=35). Average abundance was 10 or less for all remaining species.

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Kilmacshane Bog. Greenland White-Fronted Goose, on the two occasions it was recorded, was directly associating with habitats on site, which is notable given its declining status. Kilmacshane is subject to periodic

inundation from the River Shannon during the winter months and many of the water obligates recorded associate with open water bodies established as a result.

Discussion

Regarding species richness the numbers of Red or Amber listed water bird species is medium (n= 15 overall). Abundance is relatively low and only exceeds 10 individuals on average in respect of three species. The notable exception during the period studied is perhaps Whooper Swan, with a maximum count of 377 birds. This is above the 1% National Threshold for wintering Whooper Swan (150 – see Burke *et al.* 2018a) and Kilmacshane appears to be an important winter refuge for this species. In the past Kilmacshane has similarly held Nationally Important numbers of this species (Lewis *et al.* 2019). During the current study period, this threshold was exceeded on three occasions (December, January, and February). Greylag Geese occur in numbers above the National Threshold for importance (35) however without information on the exact provenance, birds at Kilmacshane are assumed to be resident (i.e. feral) rather than migratory. Nonetheless the average number at Kilmacshane exceeds the threshold established for monitoring of even feral birds (n=20).

The other notable occurrence was that of Greenland White-fronted Goose, albeit in low numbers and on only two occasions. Some Greenland White-fronted Geese were also recorded at the adjacent Garryduff Bog over the winter 2021/22 period and there may be interchange on a regular basis between these bogs. It is notable that rehabilitation at Kilmacshane and other bogs nearby may provide habitat for this species in this area.

Overall, Kilmacshane is an important refugium for a number of wintering water bird species, and in the context of two nearby European Sites (the River Suck Callows SPA and Mid Shannon Callows SPA) both of which have for instance Whooper Swan, Golden Plover, Lapwing and '*Wetland and Waterbirds'* as qualifying interests a post rehabilitation Kilmacshane may contribute to further habitat for SCI species and support the conservation objectives for these European Sites. No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far at Kilmacshane, but measures have consolidated conditions for wetland habitats to continue to improve condition to support wintering bird species already using the site.

Table 2.5.1: Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	**BOCCI 2020 - 2026 STATUS**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**Mean**	**Maximum**
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	0	0	0	11	0	0	2	11
CO Coot *Fulica atra*	Amber	0	0	0	1	0	0	0	1
CS Common Sandpiper *Actitis hypoleucos*	Amber	2	0	0	0	0	0	0	2
CU Curlew *Numenius arquata*	Red	0	0	0	1	0	0	0	1
GJ Greylag Goose *Anser anser*	Amber	0	55	65	62	98	57	56	98

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Maximum
GP Golden Plover *Pluvialis apricaria*	Red	0	20	0	12	30	0	10	30
H. Grey Heron *Ardea cinerea*	Green	1	3	2	1	1	0	1	3
HW Great Egret *Ardea alba*	N/A	0	1	1	1	0	0	1	1
L. Lapwing *Vanellus vanellus*	Red	0	60	40	96	9	5	35	96
LG Little Grebe *Tachybaptus ruficollis*	Green	0	1	2	0	0	5	1	5
MA Mallard *Anas platyrhynchos*	Amber	0	13	8	6	9	3	7	13
MS Mute Swan *Cygnus olor*	Amber	5	10	17	10	10	6	10	17
RP Ringed Plover *Charadrius hiaticula*	Amber	0	0	0	0	0	7	1	7
SN Snipe *Gallinago gallinago*	Red	0	4	6	1	0	0	2	6
SV Shoveler *Anas clypeata*	Red	0	0	6	0	0	0	1	6
T. Teal *Anas crecca*	Amber	0	3	6	0	0	4	2	6
NW Greenland White-fronted Goose *Anser albifrons flavirostris*	Amber	0	0	0	0	12	12	4	12
WS Whooper Swan *Cygnus cygnus*	Amber	0	99	127	171	377	268	174	377

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 3 no. transects (15 no. 200m sections) which were visited two times in the period June to July 2022 inclusive. We refer to the Method and materials master text for survey methodology in respect of CBS, and to the constraints section below regarding the timing of visits. All counts were completed within the period 06:30am - 09:30am. All counts were conducted in weather conditions comprising zero rain, good visibility and zero wind. See the figure in Appendix F2 titled '*Kilmacshane Bog Ecology Transects'* for transect locations.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, head lands or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent

to these areas i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the discussion section.

Regarding visits the first and second visits were both outside their recommended period (Early April – mid-May for visit 1 and mid-May to Late June for Visit 2). Results are therefore interpreted as if only a visit 2 was effectively conducted (based on a survey date of June 2nd). On this basis it is acknowledged that some early breeding species may be omitted from the data. In addition, species recorded in July only are treated as supplementary to the primary breeding data collected - even if breeding was still possible. This includes Blue Tit, Chiffchaff, Curlew, Little Egret, Magpie, Pied Wagtail, Redshank and Starling – referred to with the qualifier JO (July Only) below. These species are still included in Species Richness estimates as there is some validity around their usage of cutaway during the study period.

Results- Species Richness

Species richness is presented as the total number of species recorded across all transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant. As noted above species recorded in July only are also included.

A total of 43 no. species were recorded, see Table 2.5.2. This included six BOCCI (Gilbert *et al.* 2021) Red listed species Black headed gull, Curlew (JO) , Lapwing, Meadow Pipit, Redshank (JO) and Snipe along with 13 no. BOCCI Amber listed species namely Common Gull, House Martin, Linnet, Mallard, Mute Swan, Ringed Plover, Skylark, Starling (JO), Swallow, Teal, Wheatear and Whooper Swan. Remaining species were all Green listed apart from Pheasant which is not assigned a BOCCI status.

Although a bespoke breeding waders survey was not undertaken, data on wading species recorded is herein presented in line with an interpretation following the O'Brien and Smith (1992) method for censusing lowland breeding wader populations. This is interpreted as a minimum estimate for Kilmacshane and on this basis up to 8 pairs of Ringed Plover bred on site. Ringed Plover chicks were also observed during the study period. It is likely but not proven that Lapwing and Snipe also attempted to breed on site in 2022.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species per visit (E or L) or as the maximum count for the period April to June inclusive, see Table 2.5.2. This allows for future comparison with CBS trends which takes the same approach to index species. Maximum counts of greater than 20 individuals were recorded for four species, Mallard (n=31), Meadow Pipit (n=28), Swallow (n=27) and Lapwing (n=24). Maximum counts of 10-19 individuals were recorded for nine species, with the highest being Ringed Plover (n=17) followed by Willow Warbler (n=15), then Snipe (n=14). A total of 30 species occurred at a maximum abundance of nine individuals or less.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Fifteen species considered associated with NON-OPEN

habitats were recorded and twenty-seven species associated with OPEN habitats were recorded see Table 2.5.2. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were noted.

Discussion

Regarding species utilising the bog in the breeding season it is notable that 19 of the total 43 species recorded (44%) are of conservation concern and are either Red or Amber BOCCI listed. Not all were proved to breed onsite in 2022 and it is considered highly unlikely that some e.g. Curlew (recorded in July only) would breed. Nonetheless the data presented here suggests the importance of Kilmacshane for many species of conservation concern during the summer months, either for foraging or roosting or indeed breeding. Regarding wading species breeding was proved for Ringed Plover as chicks were observed. It is also highly likely that Lapwing and Snipe bred onsite in 2022. Due to the absence of a visit in the period mid-April to late-May we have not assigned definite breeding status to Lapwing for instance, but the occurrence of 24 individuals in June suggests breeding was possible if not likely. Similarly in respect of Snipe, as no birds were recorded in May (O'Brien and Smith advises that if no Snipe were recorded in May then maxima should not be reported as the total number of breeding pairs), we have been conservative around breeding estimates, but the occurrence of 14 (drumming or chipping) individuals in June supports likely breeding. We note that once rehabilitation stabilises [redacted]

Regarding breeding season habitat association, 63% of the overall species recorded are considered to associate with open habitats such as those created by rehabilitation. Regarding species of conservation concern (Red or Amber), 89% of these species recorded associate with open habitats. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this is borne out also at Kilmacshane.

In conclusion, the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway bogs (pre or post rehabilitation) and establishes the potential importance of Kilmacshane in respect of breeding birds of conservation concern. Given Kilmacshane overlaps the Middle Shannon Callows SPA it is possible that in time the effects of rehabilitation will support conservation objectives for this European Site and contribute to Article 12 reporting. No significant change in breeding bird species richness and abundance can be attributed to the peatland rehabilitation so far at Kilmacshane, but measures have consolidated conditions for wetland habitat to continue to develop to support breeding bird species already using site.

Table 2.5.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	13
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	7
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	4
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	0
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	0
CG Common Gull *Larus canus*	Amber	OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	7

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
CK Cuckoo *Cuculus canorus*	Green	OPEN	6
CU Curlew *Numenius arquata*	Red	OPEN	0
ET Little Egret *Egretta garzetta*	Green	OPEN	0
GT Great Tit *Parus major*	Green	NON-OPEN	1
H. Grey Heron *Ardea cinerea*	Green	OPEN	11
HC Hooded Crow *Corvus cornix*	Green	OPEN	12
HM House Martin *Delichon urbicum*	Amber	OPEN	13
L. Lapwing *Vanellus vanellus*	Red	OPEN	24
LG Little Grebe *Tachybaptus ruficollis*	Green	OPEN	5
LI Linnet *Carduelis cannabina*	Amber	OPEN	2
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	8
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	5
MA Mallard *Anas platyrhynchos*	Amber	OPEN	31
MG Magpie *Pica pica*	Green	NON-OPEN	0
MH Moorhen *Gallinula chloropus*	Green	OPEN	9
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	28
MS Mute Swan *Cygnus olor*	Amber	OPEN	2
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	4
PW Pied Wagtail *Motacilla alba*	Green	OPEN	0
R. Robin *Erithacus rubecula*	Green	NON-OPEN	9
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	12
RK Redshank *Tringa totanus*	Red	OPEN	0
RP Ringed Plover *Charadrius hiaticula*	Amber	OPEN	17
S. Skylark *Alauda arvensis*	Amber	OPEN	1
SC Stonechat *Saxicola rubicola*	Green	OPEN	8
SG Starling *Sturnus vulgaris*	Amber	NON-OPEN	0
SL Swallow *Hirundo rustica*	Amber	OPEN	27
SN Snipe *Gallinago gallinago*	Red	OPEN	14
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	5
T. Teal *Anas crecca*	Amber	OPEN	2
W. Wheatear *Oenanthe oenanthe*	Amber	OPEN	1
WA Water Rail *Rallus aquaticus*	Green	OPEN	4
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	2
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	12
WS Whooper Swan *Cygnus cygnus*	Amber	OPEN	3
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	15

Pollinators

No Pollinator survey was required at Kilmacshane bog under the agreed Monitoring and Verification scope.

2.5.3 Surface Water Quality

This bog Kilmacshane bog has a total of five surface treated water outlets to the Shannon Lower IE_SH_25SO12060. Three of these outlets are monitored as part of EDRRS (SW 16, 17, & 18) and these outlets are shown on Drawing No. BNM-DR-22-05-32.

Analysis over the past 5 years of the IPC licence environmental monitoring programme, indicate that recommended parameters like Suspended solids had an average of 9.6 mg/l with Ammonia averaging 0.53 mg/l, as per results below.

Table 2.5.3: Kilmacshane Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS mg/l	TS mg/l	Ammonia mg/l	TP mg/l	COD mg/l	Colour
Kilmacshane	SW-14	Q3 17	8	8	406	0.88	0.05	48	83
Kilmacshane	SW-16	Q3 17	7.8	5	268	0.08	0.05	73	103
Kilmacshane	SW-17	Q3 17	7.8	5	172	0.69	0.05	60	172
Kilmacshane	SW-18	Q3 17	7.9	5	318	0.52	0.05	46	106
Kilmacshane	SW-19	Q3 17	8	5	442	0.44	0.05	58	231
Kilmacshane	SW-18	Q3 20	8	30	381	0.568	0.06	69	149

Monthly EDRRS baseline monitoring commenced in November 2020, which gave 22 sampling events for this report, up to August 22. During this monitoring period, the suspended solids averages were 6mg/l (SW16), 5.9 mg/l (SW17) and 7.6 mg/l (SW18).

Ammonia results show an average of 0.285 mg/l (sw16), 0.266 mg/l (SW17), and 0.134 mg/l (SW18), with an overall average of .227mg/l, which is less than when the bog was in active production and is trending slightly downwards to date. Rehabilitation commenced in May 2021 and over all trends in these two parameters remained reasonable unchanged with some slight increases in suspended solids, but still below the average for when in active production. During this period with significant drain blocking and some cell formation, there were some noticeable peaks in suspended solids in the winter months but below levels of concern or licence compliance.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.67.

Surface water monitoring for the period and associate graphs are in Appendix F3.

2.5.4 Archaeology

Kilmacshane Bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, the line of the Grand Canal (RMP GA101-

007--- and RMP GA109-054---) and a holy well (RMP GA109-008---) were avoided by the rehabilitation works with a 20m buffer, with the Grand Canal RMP GA101-007--- and RMP GA109-054--- extending through the whole length of Kilmacshane.

2.5.5 Aerial Imagery / LiDAR

Kilmacshane Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in December 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Kilmacshane Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.6 Boora Bog

Boora Bog is located in Co. Offaly, ca.1.5km north of Kilcormac Village. The overall Boora bog is divided into two main sections, often assigned the designation Boora East and Boora West. The area of the bog is 1,851 hectares. Boora Bog was in peat production since the early 1950's. Boora Bog is also the site of Lough Boora Discovery Park which has a network of off-road walking and cycling routes within a perimeter of approximately 20 kilometres. Further information on the bog is available in the Boora Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on this bog in August 2021 and was 64% complete at the end of June 2022.

2.6.1 Hydrological monitoring

Hydrological monitoring is ongoing at Boora Bog. A total of 27 Phreatic wells have been installed, where 12 Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. BNM-DR-22-15-32 in Appendix G0. A total of four monitoring visits have been carried out to date at Boora Bog as outlined in Appendix G1 - Boora Bog - Hydrological Monitoring, completed in May 2021, July 2021, February 2022 and July 2022. Monitoring will be ongoing at Boora Bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works on Boora Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed on Boora Bog. It is envisaged that completion of these measures will have an impact on ground water levels generally.

A summary of manual readings is provided in Table G1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data suggests higher water table levels across most wells in Summer 2022 compared to Summer 2021. There are a small number of exceptions where the water table in summer 2022 was deeper than 2021; however, it is important to note that a single manual reading at a point in time does not consider the different in weather conditions leading up to the monitoring taking place. A review of logger data for a small number of wells indicates that water levels have increased following the implementation of rehabilitation measures. At BO_019s there was an obvious increase in water levels in early October 2021, corresponding to the implementation of rehabilitation measures (DCT1) in this area. Despite water levels remaining deep below ground surface in this area, water levels have consistently

remained >15cm higher than prior to rehabilitation. This is an area where it was anticipated that rewetting would be difficult (hence selection of DCT1 measures); however, it is clear that the drain blocking measures have resulted in an increase to the water table height in this area. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

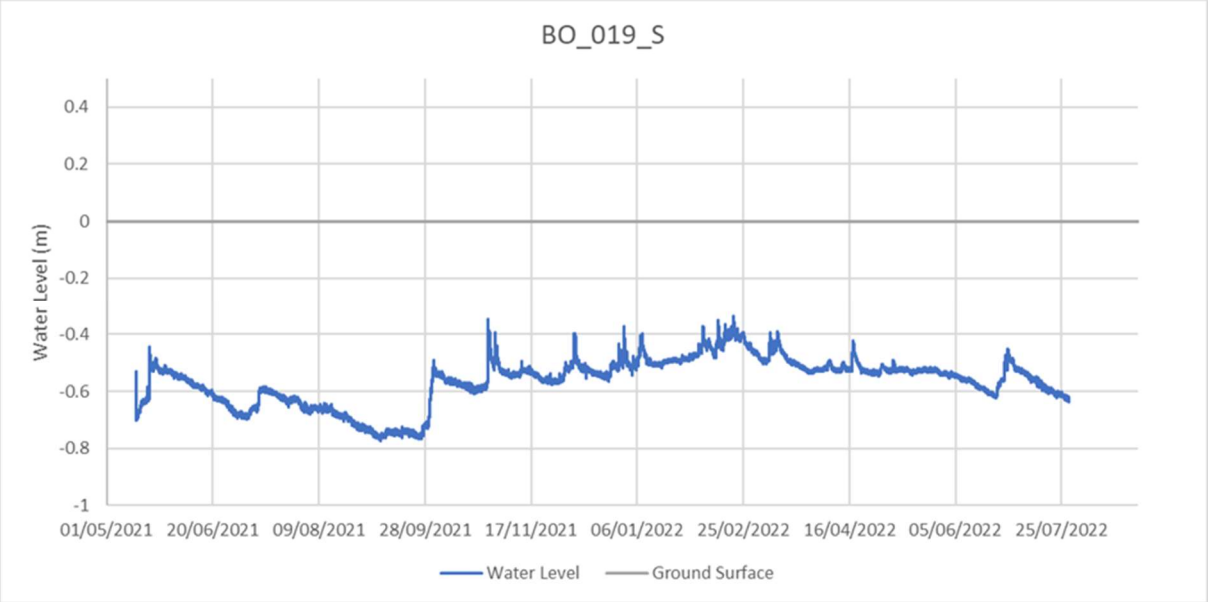

Figure 2.6.1: Hydrograph for monitoring well B0_019s

2.6.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Boora Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Boora Bog is divided into two main sections, Boora East and Boora West for ease of survey, divided by the Leabeg to Kilcormac local road. This bog has a long peat extraction history and subsequently has some of the oldest developing cutaway. The EDRRS rehabilitation works were mostly confined to area in most recent peat extraction in the west part of Boora West, therefore the description of the habitats present refers to those within the rehab footprint.

North West Boora
This area includes the western side of Boora from the central rail line northwards. The cutaway area has already re-vegetated, mainly with a mixture of the two communities 'Open *Betula*-dominated community' (oBir) and 'Closed *Betula* scrub community' (cBir) along with open habitats such as

grassland and poor fen (PF2). In the north-west corner of this sub-section there are areas of calcareous grassland (GS1), scrub (WS1) and conifer plantation (WD4). The Silver River flows along the western boundary of this area. Targeted drain-blocking was carried out in this section.

South West Boora
This sub-section of Boora west encompasses the area directly to the south of the central railway line. This area was the last large area of Boora used for peat extraction. This area was a mixture of former bare peat (BP) production fields and re-vegetated cutaway. The pioneer vegetation is a mixture of 'Open *Betula*-dominated community' (oBir) and 'Closed *Betula* scrub community '(cBir), poor fen (PF2) vegetation with some small patches of shallow surface water. Drain blocking, cell construction and bunding has been carried out to re-wet this area.

This area now comprises of areas of shallow surface water, bare peat, Reed beds and pioneer fen vegetation. Vegetation communities in this area include the following: 'Pioneer *Eriophorum angustifolium* community (poor fen)'(pEang), 'Pioneer *Triglochin palustris* community' (pTrig), '*Phragmites australis* community'(pPhrag), '*Anthoxanthum-Holcus-Equisetum* community' (gAn-H-Eq) and '*Tussiligo*-dominated vegetation (vegetation > 50%)' (DisCF). The measures have been particularly effective in encouraging new vegetation colonisation where there has already been existing pioneer vegetation. Areas with deeper residual peat are less vegetated and still dominated by bare peat and shallow surface water.

<u>Lough Boora Discovery Park</u>
Much of the cutaway has been developed as conifer plantation (WD4) by Coillte (1980-1990s), or as part of the Lough Boora Discovery Park. A significant portion of cutaway within the Lough Boora Discovery Park has been actively rehabilitated and this includes the construction of two lakes and a large wetland area (Leabeg wetlands). Limited measures were carried out in this section as habitats and land-use are well established.

Mesolithic site and surrounding areas
This area is located towards the centre of Boora west and is part owned by the IWT and it is managed for nature conservation. It is almost completely surrounded by conifer plantation (WD4) and can be accessed by the main cycle path, which runs through this sub-section. Much of the former lake basin (IWT area and adjacent Bord na Mona-owned area) was also ditched and developed into fields. However, there are sections of this area and the Mesolithic storm beach that were not stripped of vegetation and retain fen habitats. The former Boora lake basin now contains a small area of developing '*Betula-Salix* woodland' (BirWD) that is mainly spreading into fen (PF1/2) type vegetation. Targeted drain-blocking was carried out in this section.

Rehabilitation was carried out at this Bog in 2021. It is too soon for cutaway habitats at Boora to reflect post rehabilitation change or vegetation/habitat succession. However, Boora West is one site where there has been rapid change since 2019 when peat extraction ceased from mostly bare peat to mostly pioneer vegetation cover. The fen and Reedbed habitats will continue to develop post rehabilitation. In conclusion the habitats recorded in 2021 and 2022 largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in condition that continue to encourage rapid changes in development of pioneer vegetation cover.

Figure 2.6.2 Open Betula-dominated community and closed Betula scrub community.

Figure 2.6.3 Bare peat in the former production fields in the west of the site.

Figure 2.6.4 Pioneer Poor Fen dominated by *Typha latifolia* and Birch scrub.

Figure 2.6.5 Open water with stands of *Typha latifolia*.

Vegetation Quadrats – Monitoring YR1

No vegetation quadrats were scoped for inclusion in annual Monitoring and Verification at Boora.

Winter Birds – Monitoring YR1

Method

Counts were carried out in the period September 2021 to March 2022 inclusive (7 no. in total) and generally spanned the period from 08:00am to 16:30pm.

Constraints

All counts were carried out in conditions generally good for recording water birds. Some disturbance to Lapwing was noted during the March count in response to the presence of a Northern Harrier *Circus hudsonius.* Access was limited away from established tracks due to Avian Flu.

Results – Species Richness

A total of 12 water bird species were recorded across all surveys. Four of these were BOCCI (Gilbert *et al.* 2021) Red listed species namely Curlew, Golden Plover, Lapwing and Snipe. Six Amber listed species were recorded namely Black-headed Gull, Greylag Goose, Mallard, Mute Swan, Teal and Whooper Swan. All other species (n=2) were Green listed.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.6.1 and was highest for Greylag Goose (n=46). A peak of 230 Greylag Geese was present in September of 2021 and this species was present on six of seven counts (these are considered feral not Icelandic migrants). Mean abundance was second highest for Lapwing (n=31). This species was recorded on five of the seven counts and a maximum of 120 was present in the study area in January of 2022. Mallard and Black-headed Gull were the next most abundant species (means of 23 and 11 respectively). Average abundance for all other species (n=8) was 5 or less.

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Boora Bog including rehabilitated cutaway along with two ornamental lakes at Boora. The latter attracts large numbers of wildfowl such as Mallard, Greylag Geese and Lapwing during the winter period.

Discussion

Wintering water bird assemblages at Boora have been well documented previously in unpublished reports such as Copland, 2009, have been summarised in birdwatching resources in the public domain [8] and in other reporting such as the Mid-Shannon Bird Reports. Reporting on IWeBS (the Irish Wetland Bird Survey) has documented the prior occurrence at Boora of high, nationally important numbers of several species, namely Little Grebe, Mallard, Golden Plover and Lapwing (Crowe, 2005), although this appraisal included results from a number of count units not included in the present study. The current study has focussed on the Boora Lakes and nearby cutaway and has avoided counting areas such as Tumduff Mor or the Finnamores Lakes, due east of Boora, as these locations are not proximal to any intervention under the current scheme. These areas are of course known to hold large numbers of wintering wildfowl, including substantial numbers of Golden Plover, which may also occasionally use the Boora Lakes, although large numbers were not recorded during the present study. Species richness is considered medium in the current study.

A high proportion (83%) of the species which were recorded in the current monitoring are of conservation concern currently in Ireland and it is notable that rehabilitation may provide further habitat for many of these species and contribute to the overall conservation and species richness of the larger Boora complex. Greylag Goose numbers are high for a feral flock and approach the 10% threshold for feral birds in Ireland (estimated population circa 2,800). No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far at Boora, but measures have consolidated conditions for wetland and peatland habitat to develop to support wintering bird species already using site.

[8] Wings Nov08 3-14.qxp (birdwatchireland.ie)

Table 2.6.1: Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	MEAN	MAX
BH Black-headed Gull *Chroicocephalus ridibundus*	Amber	7	8	9	0	0	11	41	11	41
CU Curlew *Numenius arquata*	Red	0	0	2	0	10	0	0	2	10
GJ Greylag *Goose Anser anser*	Amber	230	38	42	2	0	4	4	46	230
GP Golden Plover *Pluvialis apricaria*	Red	0	0	0	0	2	0	0	0	2
L. Lapwing *Vanellus vanellus*	Red	65	12	11	0	120	0	11	31	120
LG Little Grebe *Tachybaptus ruficollis*	Green	4	4	5	0	0	0	2	2	5
MA Mallard *Anas platyrhynchos*	Amber	27	26	31	41	6	20	7	23	41
MH Moorhen *Gallinula chloropus*	Green	8	8	7	6	1	3	4	5	8
MS Mute Swan *Cygnus olor*	Amber	21	0	0	2	5	7	2	5	21
SN Snipe *Gallinago gallinago*	Red	0	0	0	0	0	0	1	0	1
T. Teal *Anas crecca*	Amber	0	0	0	0	0	0	2	0	2
WS Whooper Swan *Cygnus cygnus*	Amber	0	6	0	0	0	0	0	1	6

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 2 no. transects (10 no. 200m sections) which were visited two times in the period April to June 2022 inclusive. We refer to the Method and materials master text for survey methodology in respect of CBS, and to the constraints section below regarding the timing of visits. All counts were completed within the period 06:30am -09:00am. All counts were conducted in weather conditions comprising zero rain, with good visibility. Wind conditions were noted as breezy on the June visit. See Figure in Appendix G2 titled '*Boora Bog Ecology Transects'* for transect locations.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, head lands or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to these areas i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section. There were no constraints noted for the surveys described in this section.

Results- Species Richness

Species richness is presented as the total number of species recorded across all transects. For completeness, any additional species recorded off transect (or on additional visits) but considered to be associating with habitats on site on any single visit are also included.

A total of 26 no. species were recorded, see Table 2.6.2. This included six BOCCI (Gilbert *et al.* 2021) Red listed species namely Black-headed Gull, Lapwing, Meadow Pipit, Redshank, Swift and Snipe along with 4 no. BOCCI Amber listed species namely Greylag Goose, Mallard, Skylark and Willow Warbler. Remaining species (n=16) were all Green listed [redacted]

Lapwing was proved to breed in Boora West rehabilitation area as at least 2 chicks were observed on a non-CBS visit on May 30, 2022. A peak of 10 adult Lapwing were recorded on this date, suggesting up to 5 territorial pairs were present at or close to the rehabilitation extent. In addition, 14 Black-headed Gulls, a displaying Redshank, [redacted]

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species per visit (E or L) or as the maximum count for the period April to June inclusive, see Table 2.6.2. This allows for future comparison with CBS trends which takes the same approach to index species. Maximum counts of greater than 20 individuals were recorded for two species Willow Warbler (n=22) and Robin (n=21). Maximum counts of 10-19 individuals were recorded for five species, with the highest being Black-headed Gull (n=14) followed by Chaffinch (n=13), Blackbird (n=11), Wren (n=11) and Lapwing (n=10). A total of 19 species occurred at a maximum abundance of nine individuals or less.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn

& O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutaway/cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Thirteen species considered associated with NON-OPEN habitats were recorded and thirteen species associated with OPEN habitats were recorded see Table 2.6.2.

Results – Colonial Species

The 14 Black-headed Gulls recorded separately to CBS visits on May 30, 2022 appeared to be a newly established colony on rehabilitated cutaway.

Discussion

The occurrence on cutover, cutaway or raised bog of many of the species recorded in this study have been previously described in literature such as Nairn & O'Halloran 2012, Wilson 1990, Bracken *et al.* 2008 and in unpublished reports such as Copland 2009, 2010.

Regarding species utilising the study area in the breeding season 10 of the total 26 species recorded (62%%) are of conservation concern and are either Red or Amber BOCCI listed. This includes breeding waders such as Lapwing and Redshank and Gull species notably Black-headed Gull. The latter has not previously bred in the portion of the study area subject to rehabilitation under the present scheme (Boora West) and the establishment of a new, although small, colony of this declining species is noteworthy. The presence of Redshank in Boora West is also notable, this species has been recorded breeding previously at Boora (adjacent to the Boora Lakes/Sculpture Park (Copland, 2009)) but not in Boora West and this is clear indication of habitat creation following rehabilitation for another Red listed species.

Regarding habitat associations, in total 9 of the 10 species listed as either Red or Amber are associated with open habitats. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009) and the retention of high quality open habitat following rehabilitation should be a priority. Overall, the data presented here demonstrates positive quality effects on bird assemblages following rehabilitation under the current scheme and points to ongoing benefits to species of conservation concern as a result of EDRRS. No significant change in breeding bird species richness and abundance can be attributed to the peatland rehabilitation so far at Boora, but measures have consolidated conditions for wetland habitat to continue to develop to support breeding bird species already using the site.

Table 2.6.2: 2022 – Monitoring YR1 Breeding Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
[redacted]	N/A	OPEN	1
B. Blackbird *Turdus merula*	Green	NON-OPEN	11
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	2
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	14
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	13
CT Coal Tit *Periparus ater*	Green	NON-OPEN	1
D. Dunnock *Prunella modularis*	Green	NON-OPEN	7
GJ Greylag Goose *Anser anser*	Amber	OPEN	2
H. Grey Heron *Ardea cinerea*	Green	OPEN	2
HC Hooded Crow *Corvus cornix*	Green	OPEN	6
JD Jackdaw *Corvus monedula*	Green	NON-OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	10
MA Mallard *Anas platyrhynchos*	Amber	OPEN	5
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	4
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	3
R. Robin *Erithacus rubecula*	Green	NON-OPEN	21
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	1
RK Redshank *Tringa totanus*	Red	OPEN	1
S. Skylark *Alauda arvensis*	Amber	OPEN	3
SI Swift *Apus apus*	Red	OPEN	5
SN Snipe *Gallinago gallinago*	Red	OPEN	2
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	1
WH Whitethroat Sylvia communis	Green	NON-OPEN	1
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	3
WR Wren *Troglodytes troglodytes*	Green	NON-OPEN	11
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	22

Pollinators

No bespoke Pollinator surveys were scoped as part of agreed Monitoring and Verification at Boora Bog.

2.6.3 Surface Water Quality

West Boora bog has one treated surface water outlet, which is monitored as part of EDRRS (SW11) and the location of this outlet is shown on Drawing No. BNM-DR-22-15-32.

Analysis of any available monitoring over 5 years of the IPC licence environmental monitoring programme when this bog was in active production, indicate that relevant parameters like Suspended Solids had an average of 12.3 mg/l, with Ammonia averaging 1.31 mg/l, as per results below.

Table 2.6.3: Boora Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS	TS	Ammonia	TP	COD	Colour
West Boora	SW-11	Q2 20	7.6	4	481	0.916	<0.05	52	183
West Boora	SW-11	Q3 18	7.7	5	358	1.5	0.05	52	173
West Boora	SW-11	Q1 17	7.5	28	412	1.5	0.05	57	130

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 24 sampling events for this report, up to August 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 5.6mg/l. Similarly, Ammonia had an average of 0.258 mg/l, which is less than when the bog was in active production and trended in an improving trajectory.

Boora rehabilitation commenced in August 2021 and since then overall trends are showing improvement in water quality during the period with a lagging response to rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there was one noticeable peak in suspended solids of 10mg/l above the average of 5.6mg/l.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.7.

Surface water monitoring for the period and associate graphs are in appendix G3.

2.6.4 Archaeology

Boora bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, archaeological sites RMP OF023-005---Habitation Site and SMR OF023-026---- Redundant Record, was avoided by the rehabilitation works with a 20m buffer zone.

2.6.5 Aerial Imagery / LiDAR

Boora Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Boora Bog was carried out in

July 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.7 Derries Bog

Derries Bog is located in Co. Offaly, just over 4km south east of Ferbane. The area of the bog is 371 hectares. The majority of Derries Bog was in in peat production from the 1960's until 2005. Further information on the bog is available in the Derries Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on this bog in August 2021 and was completed in May 2022.

2.7.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Derries Bog. A total of 17 Phreatic wells have been installed, where 7 Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. BNM-DR-22-16-32 in Appendix H0. A total of four monitoring visits have been carried out to date at Derries Bog as outlined in Appendix H1 - Derries Bog - Hydrological Monitoring, completed in May 2021, July 2021, January 2022 and August 2022. Monitoring will be ongoing at Derries Bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Table H1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were typically higher in summer 2021 than summer 2022, although there are a number of clear exceptions with deeper water levels at some monitoring wells. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. Logger data from well DER_014_S shows an increase in the water levels between summer 2021 and winter 2021 but water levels do decrease to similar levels in summer 2022. A more complete data set would be required to make a complete analysis but there was a clear increase in water levels in October 2021, following formation of the cells. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

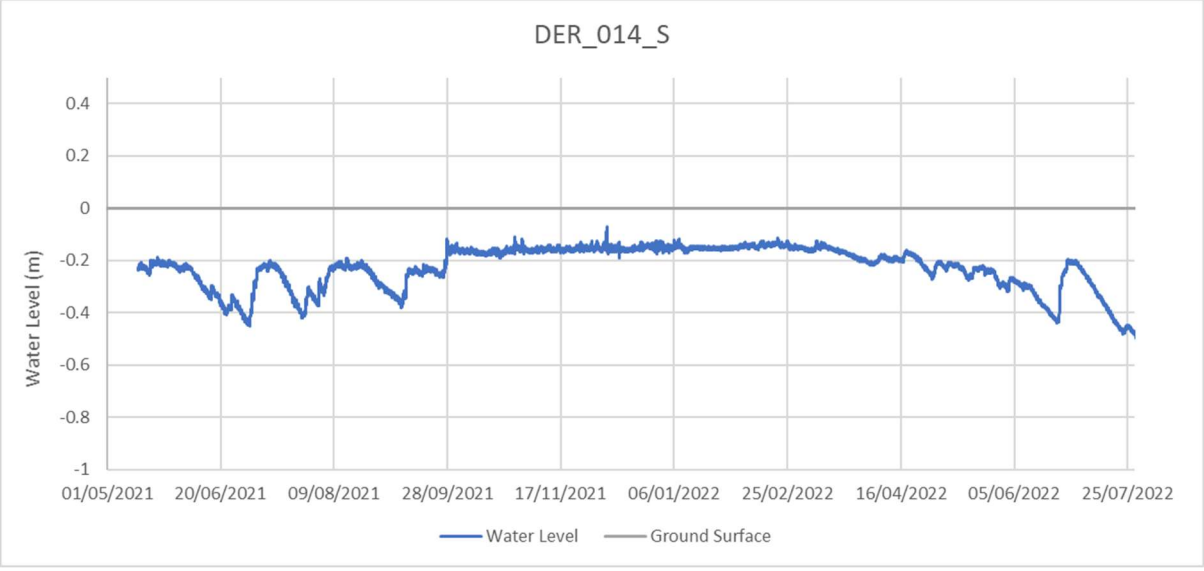

Figure 2.7.1: Hydrograph for monitoring well DER_014s

2.7.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Derries Bog in 2022.

Constraints

No constraints were identified.

Results

The Derries is a small-medium sized site with the majority of the former peat extraction area now re-vegetated. The majority of the site has been cutaway for some time and more established habitats have developed. The most common habitats include a mosaic of *Betula*-dominated scrub communities at different stages of development and several poor fen pioneer communities, of which the category 'Pioneer *Juncus effusus* community' (pJeff) is most prominent. EDRRS measures were targeted across the site to improve re-wetting, with some more intensive measures used on small are of bare peat.

The southern section of the bog has quite mature habitats and bare peat is a minor component. Some of the *Betula pubescens* dominated scrub (eBir/oBir) is beginning to close and will soon develop Birch woodland particularly along the south-western boundary where the *Betula pubescens* seems to have emerged from a 'Dry *Calluna* community' (dHeath). There is some open water (OW) scattered around the site forming pools and lakes of various sizes and depths, although none are extensive. Around these open water areas there are a mosaic of wetland communities, including some fringing Reedbeds, dominated by the '*Typha* community' (pTyp), and poor fen pioneer communities showing some typical zonation from wet to dry zones. Some of these pools are completely covered with *Typha latifolia*, forming some large Reedbeds, but none are extensive relative to the overall size of the site.

There are several 'mineral mounds' or low hills formed by underlying glacial material. The vegetation on these areas is drier and dominated by the category 'Dry *Calluna* community' (dHeath), with some dry 'Open *Betula*-dominated community' (oBir), a minor amount of dry calcareous grassland (gCal) and disturbed or colonising vegetation including the '*Tussiligo*-dominated community (vegetation > 50%)' (DisCF) and '*Epilobium*-dominated community (vegetation > 50%)' (DisWil). Other lower ridges pass through the southern section creating some drier grassland and scrub that crosses several former production fields. These communities are also found around the margins.

A small part of the northern half of the bog was in peat extraction until more recently and two smaller sections still comprise of a mosaic of bare peat and pioneer vegetation. The habitats in these areas are less developed with a mosaic of 'Open *Betula pubescens* community' (oBir), along with pioneer poor fen communities comprising mainly of 'Pioneer *Juncus effusus* community' (pJeff) and 'Bare peat (0-50% cover)'(BP).

It is too soon for habitats at Derries to reflect post rehabilitation change or succession. Measures have been relatively successful in improving re-wetting across the site. However, there are no indications of recent changes to more established habitats in response to these measures yet. Some initial rewetting of former areas of mainly bare peat have been noted post the implementation of the EDRRS measures. These measures encouragement the expansion of wetland habitats at this site.

In conclusion the habitats recorded in 2022 largely reflect the baseline status of the bog.

Figure 2.7.2 Example of residual deep bare peat within the northwest of the bog (within DPT4 cells).

Figure 2.7.3: Bare peat recolonising with Pioneer *Eriophorum angustifolium* dominated community (foreground).

Figure 2.7.4: Example of small wetland with establishing reedbeds

Figure 2.7.5: Establishing woodland developing from lower 'production fields' onto bare peat dominated 'high fields'.

Vegetation Quadrats – Monitoring YR1

No bespoke vegetation quadrats were scoped as part of agreed Monitoring and Verification at Derries Bog.

Winter Birds – Monitoring YR1

No winter bird surveys were scoped as part of agreed Monitoring and Verification at Derries Bog.

Breeding Birds – Monitoring YR1

No breeding bird surveys were scoped as part of agreed Monitoring and Verification at Derries Bog.

Pollinators

No Pollinator surveys were scoped as part of agreed Monitoring and Verification at Derries Bog.

2.7.3 Surface Water Quality

Derries Bog has two treated water sampling outlets to the Brosna River IE_SH_25B090761, via the Silver River IE_SH_25S020700 and the Boora River IE_SH_25B080100. Both outlets are being monitored as part of EDRRS (SW14 & SW14A) and their location is shown on Drawing No. BNM-DR-22-16-32 in Appendix H0.

Analysis of monitoring over 3 years of the IPC licence environmental monitoring programme from this bog, indicates that relevant parameters like suspended solids averaged 38.5 mg/l with Ammonia averaging 0.21 mg/l, as per results below.

Table 2.7.2: Derries Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS	TS	Ammonia	TP	COD	Colour
Derries	SW-14	Q3 18	7.6	5	396	0.02	0.05	33	66
Derries	SW-14A	Q3 18	7.9	21	336	0.78	0.05	60	125
Derries	SW-14	Q1 17	7.5	75	370	0.02	0.05	96	253
Derries	SW-14A	Q1 17	7.4	53	342	0.02	0.05	89	239

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 24 sampling events for this report, up to August 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with 10 mg/l (SW14) and 9.5mg/l (SW14A). Similarly, Ammonia had an average of 0.221 mg/l (SW14) and 0.079 mg/l (SW14A) which is less than when the bog was in active production but mixed current trends with SW14 showing an increasing concentration.

Derries rehabilitation commenced in August 2021 and since then suspended solids rose slightly during the period with no obvious clear relationship between rainfall and concentration of run-off at this location. During this period with some drain blocking and cell formation, there were some noticeable increases in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

The pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.14.

Surface water monitoring for the period and associate graphs are in Appendix H3.

2.7.4 Carbon

Carbon monitoring is being carried out on Derries Bog. Six chamber measurement sites are located in this bog and are described in Section 3 of this report (Table 3.1). Monitoring data is not yet available for this chamber monitoring.

2.7.5 Archaeology

Derries bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, there is no known archaeological material in Derries Bog.

2.7.6 Aerial Imagery / LiDAR

Derries Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Derries Bog was carried out in July 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.8 Oughter Bog

Oughter Bog is located in Co. Offaly, circa 3km to the west of Blueball. The area of the bog is 358 hectares. Oughter bog lies to the south of the River Brosna and the Grand Canal. Industrial peat production ceased at Oughter Bog in 2012. Further information on the bog is available in the Oughter Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on Oughter Bog in July 2021 and was 67% complete by the end June 2022.

2.8.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Oughter Bog. A total of 17 wells have been installed, where 7 Phreatic wells have been instrumented with automated loggers. The location of the wells are shown on Drg. No. BNM-DR-22-08-32 in Appendix I0. A total of four monitoring visits have been carried out to date at Oughter Bog as outlined in Appendix I1 - Oughter Bog - Hydrological Monitoring, completed in May 2021, July 2021, January 2022 and August 2022. Monitoring will be ongoing at Oughter Bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works on Oughter Bog. Several key drainage features that would have an impact on ground water levels have

yet to be completed on Oughter Bog. It is envisaged that completion of these measures will have an impact on ground water levels generally.

A summary of manual readings is provided in Table I1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were typically lower in summer 2022 than summer 2021, other than at a small number of monitoring wells. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data from well OT_010_S shows the water levels have not changed significantly since 2021, with the water table typically within 20cm of the ground surface throughout summer 2021 and summer 2022. Given the water table was already close to the surface and within the optimum range of peat accumulating conditions, this corresponds with the selection of minimal intervention in this area through WLT4 measures. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

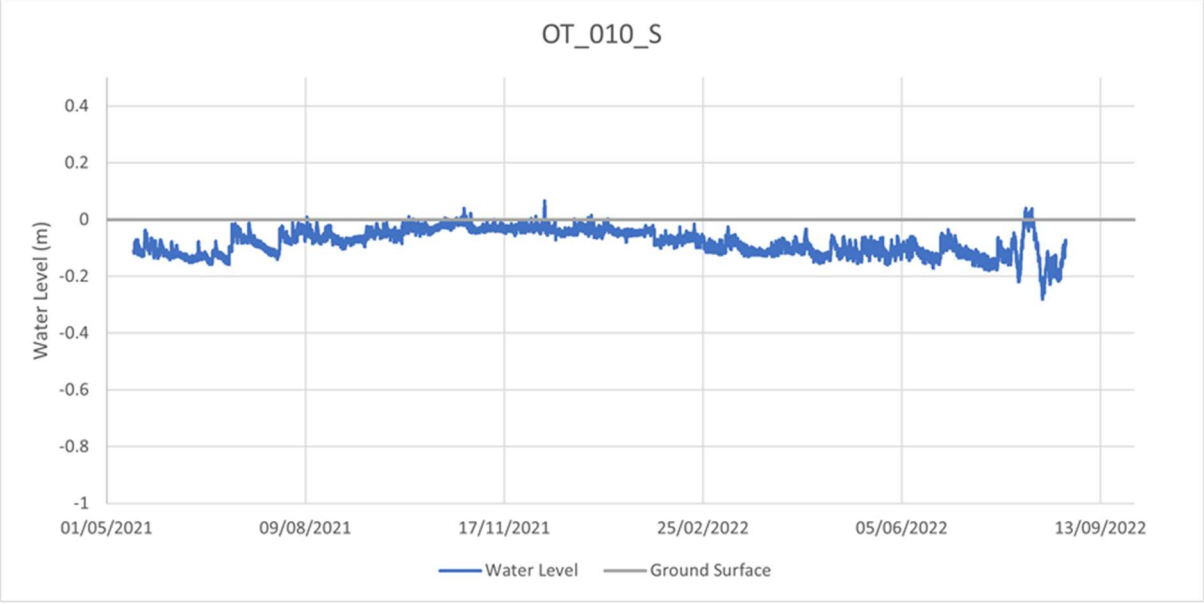

Figure 2.8.1: Hydrograph for monitoring well OT_010s

2.8.2 Biodiversity

This bog

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Oughter Bog during summer 2021. Habitat mapping consisted of ground truthing

previous habitat maps and adding data in the form of point data to represent the habitats encountered.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Oughter Bog is primarily divided into two main sections, a southern section and a northern section divided by a rail-line orientated NE-SW. Part of the bog formerly owned by Bord na Móna has been developed into a shooting range, in the south of the site.

The majority of the bog is now developing pioneer habitats. There have been significant changes in the cutaway landscape at Oughter in the past 20 years from mostly bare peat to a mosaic of mostly wetland cutaway habitats and Birch scrub/woodland (WS1/WN7).

The southern section of Oughter contains significant areas of developing pioneer fen vegetation forming in wetter areas. This is dominated by mosaics of the community categories 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang), 'Pioneer *Triglochin palustris* community' (pTrig) and '*Carex rostrata* community' (pRos). These small wetlands and old production drains also support the community 'Charophytes'(pChar) indicating the base rich conditions within areas of shallow cutaway peat. Together these are indicators of more alkaline ground-water influence and are correlated with the presence of shell marl sub-soil. Other indicators of alkaline influence include *Epipactis palustris*. *Bidens cernua* has also recently been recorded within the shallow cutaway peat within the centre of the site. Reedbeds categorised as '*Phragmites australis* community' (pPhrag) were also commonly recorded, typically in wetter areas of the bog within localised depressions.

The southern section of the bog is also developing pockets of pioneer open habitats and scrub, with mosaics of the vegetation community categories 'Emergent *Betula*-dominated community (A)' (eBir) and 'Pioneer *Eriophorum angustifolium*-dominated community (Poor Fen)' (pEang) developing on wet parts of the bog in the east. Substantial areas of the community 'Bare peat (0-50% cover)' (BP) still remain at Oughter, along headlands, travel passes and many of the former production fields, particularly within the west of the bog. Some vegetation is beginning to colonise, resulting in vegetation communities such as 'Pioneer *Juncus effusus* community' (pJeff) and 'Pioneer *Eriophorum angustifolium* vegetation (poor fen)' (pEang) and there is frequent patches of shallow standing water (not assigned a community category).

Where drier conditions occur across the site, typically within the northern lobe, significant cover of 'Pioneer *Juncus effusus* community' (pJeff) dominated vegetation occurs in association with 'Open *Betula*-dominated community (B)' (oBir) and establishing woodland/'Closed *Betula* scrub community (C)' (cBir). Although this establishing woodland within the north of the site is dominated by *Betula pubescens* some *Salix cinerea* is also establishing. Two *Sorbus hibernica* were also recorded in summer 2022 along the northern railway.

The oldest area of cutaway is located adjacent to the east side of the shooting range. This area has almost completely re-vegetated and contains a diverse mosaic of wetland communities including some indicators of Rich Fen (PF1). This area supports a relatively large area of established vegetation categorised as 'Pioneer *Cladium* community' (pCladium) which appears to have spread from the old production drains. Pioneer rich fen community with *Schoenus nigricans* (rudimentary rich fen) has also been recorded further south of here. Some areas of pioneer *Carex viridula/*brown moss community (rich fen) have also been noted.

The south-eastern lobe (further east of the shooting range) supports a large area of mature 'Dry *Calluna* community' (dHeath) on bare peat occurring in a mosaic with scattered 'Emergent *Betula*-dominated community (A)' (eBir) scrub. This community broadly corresponds to the '*Calluna vulgaris* cutover bog' (LS1) classification under Smith and Crowley, 2020. Some areas of poor fen also occur, dominated by *Eriophorum angustifolium*.

Rehabilitation was carried out at this Bog in 2021. It is too soon for habitats at Oughter to reflect post rehabilitation change or succession. However, the measures and significantly changed environmental conditions across the bog with much more re-wetting and high water levels in general.

Almost no new pioneering vegetation is present within the bare peat areas in the rehabilitation extent (see also Quadrat survey results, below). Some areas of the bog already have well established pioneer vegetation including fen, alkaline fen and scrub/woodland habitats (including Sphagnum mosses, see Plates below). These habitats will continue to develop post rehabilitation. In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site. These measures will encourage the continued development and consolidation of fen and wetland habitats at this site.

Figure 2.8.2: Example of developing open *Betula pubescens* scrub with some *Sphagnum* moss.

Figure 2.8.3: Example of pioneering habitats.

Figure 2.8.4: Rich Fen and Flush with *Cladium mariscus*.

Figure 2.8.5: Pioneer *Juncus effusus* and Birch scrub.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Oughter bog in June 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were identified.

Results

Quadrats Q1 and Q3 were dominated by bare peat (90-100% cover), with few plants recorded. Quadrat Q2 was located in an area of revegetating shallow peat that has been out of production for a few years and consequently supported a greater cover and diversity of plant species, although significant coverage of bare peat (34-50%) remains. Colonising species comprised mainly of species such as Colts foot, Yorkshire fog, Cat's ear, and Field horsetail. Quadrats Q4 and Q5 were taken in an area of pioneering habitats comprising of a mosaic of poor fen and establishing scrub. Ground cover was dominated by *Eriophorum angustifolium* and *Molinia caerulea*, with some heather. In addition, scattered *Betula pubescens* scrub is becoming established in this area. See Table 1 of Appendix I2 for detailed quadrat information.

Discussion

As with habitats the quadrats reflect the current baseline conditions following rehabilitation. Further time is required before any vegetation is likely to be recorded.

Figure 2.8.6: Quadrat Q3

Figure 2.8.7: Quadrat Q4.

Breeding Birds – Monitoring YR1

Methods

A CBS survey was carried out on April 30, 2021. Conditions on the day were amenable to recording birds with no rain, moderate cloud and light wind. The survey period was 08:10am to 08:57am. See the Figure in Appendix I2 titled '*Oughter Bog Ecology Transects'* for transect location information.

Constraints

No constraints were noted.

Results- Species Richness

A total of 25 no. species were recorded of which 3 were BOCCI Red-listed namely, Lapwing, Meadow Pipit and Snipe. Seven Amber listed species were recorded namely, Linnet, Mallard, Ringed Plover, Skylark, Swallow, Sand Martin and Willow Warbler.

Regarding waders 2-3 pairs of Lapwing, 1 pair of Ringed Plover and 9 pairs of Snipe are thought to have bred on site. See also Table 2.8.1.

Results – Annual Relative Abundance

Relative abundance was highest for Meadow Pipit (n=32) followed by Mallard (n=28) and Willow Warbler (n=11). All other species occurred in the order of 10 or less individuals.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Fourteen species associated with OPEN habitats were recorded and ten species associated with NON-OPEN habitats were recorded see Table 2.8.1. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were recorded.

Discussion

The data presented here for 2021 (YR1) suggests Oughter is suitable for a number of species of conservation concern in particular wading species such as Lapwing and perching bird species such as Meadow Pipit.

Table 2.8.1: 2021– Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	9
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	5
CK Cuckoo *Cuculus canorus*	Green	OPEN	2
H. Grey Heron *Ardea cinerea*	Green	OPEN	5
HC Hooded Crow *Corvus cornix*	Green	OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	5
LI Linnet *Carduelis cannabina*	Amber	OPEN	1
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	1
MA Mallard *Anas platyrhynchos*	Amber	OPEN	28

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
MG Magpie *Pica pica*	Green	NON-OPEN	1
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	32
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	1
R. Robin *Erithacus rubecula*	Green	NON-OPEN	3
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	6
RP Ringed Plover *Charadrius hiaticula*	Amber	OPEN	2
S. Skylark *Alauda arvensis*	Amber	OPEN	10
SC Stonechat *Saxicola rubicola*	Green	OPEN	9
SL Swallow *Hirundo rustica*	Amber	OPEN	1
SM Sand Martin Riparia riparia	Amber	OPEN	6
SN Snipe *Gallinago gallinago*	Red	OPEN	9
WH Whitethroat Sylvia communis	Green	NON-OPEN	2
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	2
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	2
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	11

Winter Birds – Monitoring YR1

Method

Fixed counts, following I-WeBS methods, were used to count wintering waterfowl at Oughter. A total of seven monthly counts were undertaken, covering the period September 2021 to March 2022 inclusive.

Constraints

There were no constraints to completing the surveys described herein.

Results – Species Richness

A total of 9 water bird species were recorded across all surveys. Golden plover, Lapwing, Snipe, Black-headed Gull and Curlew are all BoCCI Red listed species (Gilbert *et al.* 2021). Three Amber listed species were recorded, namely Whooper Swan, Greylag Goose and Ringed Plover.

Low numbers of Whooper Swan (max 3 individuals) and Greylag Goose (max 10 individuals) were recorded at this site indicating that it is likely to be of low importance for these species. Lapwing and Ringed Plover were only recorded in February and March indicating that the species does not currently use the site regularly during the winter months. The late records of this species could indicate the arrival to the site of early breeding individuals.

Similarly, Curlew and Ringed plover were only recorded in March (four individuals), although this species was not recorded during the dedicated breeding bird surveys. It is likely therefore that these individuals recorded were on passage.

Small flocks of Golden plover and low numbers of Water rail and Snipe were recorded over the winter months indicating that the site does provide some suitable supporting habitat for these species but is not used by significant numbers locally.

Results – Abundance

Average abundance was highest for Golden Plover (n=11), which was recorded on 3 of 7 no. counts. A maximum of 35 was present in September of 2021.Average abundance was 5 or less for all other species, although maximum counts of both 10 Lapwing and 10 Greylag Goose were recorded in March and October/November respectively.

Results – Habitat Associations

Most of the wintering wildfowl records were associated establishing wetland to the southeast and north of the site. Such areas support established vegetation and associated aquatic invertebrates likely provide feeding opportunities for wildfowl and waders. The low numbers of Snipe recorded is likely to reflects the species propensity to flush from such habitats when approached during the survey.

Discussion

It is clear that Oughter is only used intermittently by some wintering waterfowl species while other species occur throughout the core winter months. There are numerous small wetland features occurring at Oughter bog and thus some parts of these can be difficult to survey due to the linear nature of some former high production fields that developed scrub, as well as the some developed reedbeds.

As these features can provide shelter for some wintering wildfowl and waders, it is likely that some species have been under recorded, in particular Snipe for example. This species is difficult to count accurately due to its cryptic camouflage and fondness for resting in dense vegetation and total counts of all but the smallest wetland sites are generally underestimates (Smiddy *et al.* 2022). The maximum count for Lapwing was recorded in March of 2022 and may reflect an influx of pre-breeding individuals.

Overall species richness and abundance reflects the current baseline bog condition, with much of the site still dominated by bare peat, establishing scrub and small scattered wetlands. Over time, as supporting wetlands and associated vegetation develop at Oughter it is expected that it may also become a refugium for a greater diversity and increasing numbers of wintering wildfowl and wader species such as those recorded during the 2021-22 winter months. Post rehabilitation and associated revegetation, Oughter is expected contribute to further habitat for a variety of wintering bird species of conservation concern occurring in the wider landscape. No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far at Oughter, but measures have consolidated conditions for wetland and other habitat to continue to develop to support wintering bird species already using the site.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds, both at Oughter and other bogs rehabilitated under EDRRS.

Table 2.8.2: 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	**BOCCI 2020 - 2026 STATUS**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**MEAN**	**MAX**
WS Whooper Swan *Cygnus cygnus*	Amber	0	2	0	2	3	0	0	1	3

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	MEAN	MAX
GP Golden Plover *Pluvialis apricaria*	Red	35	25	15	0	0	0	0	11	35
L. Lapwing *Vanellus vanellus*	Red	0	0	0	0	0	7	10	2	10
GJ Greylag *Goose Anser anser*	Amber	0	10	10	8	0	8	0	5	10
SN Snipe *Gallinago gallinago*	Red	0	0	0	1	0	0	1	0	1
RP Ringed Plover *Charadrius hiaticula*	Amber	0	0	0	0	0	0	1	0	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	0	0	0	0	0	0	2	0	2
WA Water Rail *Rallus aquaticus*	Green	0	0	0	0	0	0	1	0	1
CU Curlew *Numenius arquata*	Red	0	0	0	0	0	0	4	1	4

Breeding Birds – Monitoring YR2

Methods

Three CBS visits were conducted in the period May to July 2022. See the Figure in Appendix I2 titled '*Oughter Bog Ecology Transects'* for transect location information.

Constraints

CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. The timing of some visits may have exceeded the CBS recommended period for surveying but were complete by 11:00am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 44 no. species were recorded, see Table 2.8.3. This included six BoCCI (Gilbert *et al.* 2021) Red listed species, Black-headed Gull, Lapwing, Meadow Pipit, Kestrel, Swift and Snipe. Eight BoCCI Amber listed species namely, House Martin, Lesser Black-backed Gull, Linnet, Mallard, Skylark, Swallow, Sand Martin, and Willow Warbler. Remaining species were all Green listed apart from Pheasant which is not assigned a BoCCI status.

A bespoke breeding waders survey was undertaken, data on wading species recorded is herein presented in line with an interpretation following the O'Brien and Smith 1992 method for censusing lowland breeding wader populations. Breeding waders recorded along the walked transects include; 1-2 pairs of Lapwing, 5 pairs of Snipe and 1 pair of Ringed Plover. This is treated as a minimum estimate for the site.

Results – Annual Relative Abundance

Annual Relative Abundance (ARA) is presented as the maximum count per species per visit (Early or Late) or as the maximum count for the period April to June inclusive, see Table 2.8.3. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 10 individuals were recorded for 11 species, Linnet, Robin, Skylark, Black-headed Gull, Swallow, Sand Martin, Blackcap, Wren, Meadow Pipit, Chaffinch, Blackbird and Willow Warbler. All remaining species were recorded in low numbers (typically less than 7). Overall abundance was highest for Willow Warbler with a maximum of 56 individuals recorded in the period April to July. The species with the highest relative abundance associating with cutaway habitats was Meadow pipit (n=15).

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Twenty-six species associated with OPEN habitats were recorded and seventeen species associated with NON-OPEN habitats were recorded see Table 2.8.3. One species associates with both OPEN and NON-OPEN categories (Wren).

Breeding Lapwing were generally associated with two wetlands, one located to the northwest of the headland that divides the site (between the shooting range to the east and the mature woodland located to the northwest) and another located to the southeast of the same headland (west of the shooting range). The majority of the Snipe records were also from the small wetland located to the northwest of the headland that divides the site. A pair of Ringed Plover were recorded breeding on open cutaway bog within the northwest of the site (south of the existing railway near the Derrooly stream).

Results – Colonial Species

A small colony of Black-headed Gulls were recorded within a wetland to the north of the survey area. An estimated six pares were recorded from the transect survey. However, as suitable wetland habitat exists further to the north of the survey transect, it is likely that a small number of additional pairs also breed on Oughter Bog.

Discussion

It is notable that the six Red listed species recorded, Black-headed Gull, Lapwing, Meadow Pipit, Kestrel, Swift and Snipe are associated with open habitats targeted for rehabilitation in the form of

rewetting, and would be expected to gain from many of the measures implemented (wetland creation and fertiliser application to high fields for example). For Kestrel, for example, this species will typically benefit from a greater are of hunting habitat while nesting in mature trees etc in the wider area or bog margins. The Red listed species, Meadow Pipit associates with drier open habitats and had the fourth highest relative abundance overall or highest overall for species associated with cutover i.e. open habitats. Overall, the total number of species either Red or Amber listed was 14.

Breeding waders such as Snipe, Ringed Plover and Lapwing may increase over time following peatland rehabilitation measures and the associated increase in area of suitable wetlands. In addition, species such as Common Sandpiper may also colonise the site in the future as suitable habitat develops.

In general, the abundance estimates reflect the current suitability of the existing small wetland features, fen, scrub, establishing woodland and pioneering open habitats present at Oughter for breeding birds. In time, the extensive areas of bare peat within the south of the site will provide more suitable habitat for many species.

Regarding habitat associations, just over 61% of species recorded are more associated with open habitats. Open habitat species comprise a higher proportion of Red and Amber listed species (13 no. in total), with only one Amber species (Willow Warbler) associated with non-open habitats. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case. Further analysis on trends in the ratio or relative abundance of these species over time following rehabilitation would be beneficial.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds. The singular notable change in breeding bird species richness and abundance relate to the establishment of a breeding Black-headed Gull colony post rehabilitation. This can be attributed to the peatland rehabilitation so far at Oughter. As regards other species, measures have consolidated conditions for fen and wetland habitat to continue to develop to support the remaining breeding bird species already using the site.

Table 2.8.3: 2022– Monitoring YR2 Countryside Bird Survey Results

SPECIES	BOCCI STATUS	HABITAT ASSOCIATION	AR A
B. Blackbird *Turdus merula*	Green	NON-OPEN	24
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	15
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	2
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	13
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	3
BZ Buzzard *Buteo buteo*	Green	OPEN	2
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	7
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	22
CK Cuckoo *Cuculus canorus*	Green	OPEN	2
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
ET Little Egret *Egretta garzetta*	Green	OPEN	6
GO Goldfinch *Carduelis carduelis*	Green	OPEN	1
GR Greenfinch *Carduelis chloris*	Green	NON-OPEN	1
H. Grey Heron *Ardea cinerea*	Green	OPEN	3

SPECIES	BOCCI STATUS	HABITAT ASSOCIATION	AR A
HC Hooded Crow *Corvus cornix*	Green	OPEN	6
HM House Martin *Delichon urbicum*	Amber	OPEN	2
K. Kestrel *Falco tinnunculus*	Red	OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	5
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	1
LI Linnet *Carduelis cannabina*	Amber	OPEN	9
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	7
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	2
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	2
MA Mallard *Anas platyrhynchos*	Amber	OPEN	4
MG Magpie *Pica pica*	Green	NON-OPEN	2
MH Moorhen *Gallinula chloropus*	Green	OPEN	1
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	15
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	1
PW Pied Wagtail *Motacilla alba*	Green	OPEN	4
R. Robin *Erithacus rubecula*	Green	NON-OPEN	11
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	5
RP Ringed Plover *Charadrius hiaticula*	Green	OPEN	2
S. Skylark *Alauda arvensis*	Amber	OPEN	12
SC Stonechat *Saxicola rubicola*	Green	OPEN	3
SI Swift *Apus apus*	Red	OPEN	4
SL Swallow *Hirundo rustica*	Amber	OPEN	14
SM Sand Martin *Riparia riparia*	Amber	OPEN	14
SN Snipe *Gallinago gallinago*	Red	OPEN	5
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	6
WH Whitethroat *Sylvia communis*	Green	OPEN	4
WM Whimbrel *Numenius phaeopus*	Green	OPEN	1
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	7
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	15
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	56

Pollinators – YR1

Methods

The transect survey for Oughter is 1km long. All surveys were completed between 11:50am and 05:30pm, when the temperature was at least 16°C and during good weather conditions. Two pollinator surveys were carried out in Year 1 (2021). Dates of surveys were August 28th and September 09th. This survey effort is in line with the proposed survey scope for 2021, which specified that a pollinator transect would be carried out if resources were available. See the Figure in Appendix I2 titled '*Oughter Bog Ecology Transects'* for transect locations.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results- Species Richness

A total of nine species of butterfly were recorded namely, Common Blue, Green-veined White, Meadow Brown, Ringlet, Small Copper, Small Tortoiseshell, Speckled Wood, Peacock and Large White.

In addition to butterflies the following invertebrates were also recorded during the surveys; Green Tiger Beetle (n = 2), Common Darter (n = 7) Common Hawker (n = 1), Blue Tailed Damselfly (n = 2), Common Carder bee (n = 1), *Bombus* spp. (n = 3) and Buff-tailed Bumblebee (n = 2).

Results – Annual Relative Abundance

A total of 24 individual butterflies were recorded during the surveys in 2021. Small Tortoiseshell occurred in the highest abundance (10 overall). The maximum abundance of this species was recorded during the August survey. The highest abundance of all species overall per month was recorded in August.

Results – Habitat Associations

The majority of the transect occurs on an existing rail line located to the west and north of Oughter bog. Much of this rail line supports a good diversity of flowering plant species that attract and support pollinators locally. Along many parts of the transect route, the peatland adjacent to the rail line are devoid of vegetation and largely dominated by bare peat. However, much of the cutover bog is now beginning to revegetate in the wider area. Therefore, in time there is likely to be an increase in abundance and diversity of pollinator species. It is also worth noting that given the somewhat exposed and elevated nature of the transect, this was noted to decrease the numbers of species recorded along the transect, compared with those recorded along more sheltered areas adjacent to the bog margins. In time, increasing vegetation and vegetation structure is likely to increase the numbers of pollinators recorded.

Discussion

The baseline scenario for Oughter still reflects habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators.

Table 2.8.4: 2021 – Monitoring YR1 Pollinator Survey Results

Species	**August**	**September**	**Total**
Common Blue *Polyommatus icarus*	2	1	3
Green-veined White *Pieris napi*	0	0	0
Meadow Brown *Maniola jurtina*	1	1	2
Ringlet *Aphantopus hyperantus*	1	0	1
Small Tortoiseshell *Aglais urticae*	10	0	10
Speckled Wood *Pararge aegeria*	2	0	2
Peacock *Inachis io*	1	1	2
Small Copper *Lycaena phlaeas*	1	0	1
Large White *Pieris brassicae*	3	0	3

Species	August	September	Total
Total	**21**	**3**	**24**

Pollinators – YR2

Methods

The transect survey for Oughter is 1km long. All surveys were completed between 11:50am and 05:30pm, when the temperature was at least 16°C and during good weather conditions. Five monthly pollinator surveys were carried out in Year 2 (2022) spanning the period April to August inclusive. See the Figure in Appendix I2 titled '*Oughter Bog Ecology Transects'* for transect locations.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results- Species Richness

A total of seven species of butterfly were recorded namely, Common Blue, Green-veined White, Meadow Brown, Ringlet, Small Copper, Small Tortoiseshell, and Speckled Wood. In addition to butterflies the following invertebrates were also recorded during the surveys; Common darter (n = 11), Four spotted chaser (n = 9), Brown Darter (n = 1), Common hawker (n = 1), Bombus sp. (n = 6), Black tailed skimmer (n = 4), Common Blue damselfly (n = 7), Red Tailed bumblebee (n = 1), Buff tailed bumblebee (n = 1), and Six-spot Burnet moth (n = 1).

Results – Annual Relative Abundance

A total of 47 individual butterflies were recorded during the surveys. Meadow Brown and Ringlet occurred in the highest abundance (15 overall). The maximum abundance of Meadow Brown was recorded during the July survey. The maximum abundance of Ringlet was recorded during the May survey. The highest abundance of all species overall per month was recorded in July. The lowest species abundance was recorded during the survey in June.

Results – Habitat Associations

The majority of the transect occurs on an existing rail line located to the west and north of Oughter bog. Much of this rail line supports a good diversity of flowering plant species that attract and support pollinators locally. Along many parts of the transect route, the peatland adjacent to the rail line are devoid of vegetation and largely dominated by bare peat. However, much of the cutover bog is now beginning to revegetate in the wider area. Therefore, in time there is likely to be an increase in abundance and diversity of pollinator species. It is also worth noting that given the somewhat exposed and elevated nature of the transect, this was noted to decrease the numbers of species recorded along the transect, compared with those recorded along more sheltered areas adjacent to the bog margins. In time, increasing vegetation and vegetation structure is likely to increase the numbers of pollinators recorded.

Discussion

It is possible species richness and abundance may increase in future surveys along the transect route when the adjacent bare peat dominated areas begin to revegetate and the site develops more mature

habitats. For the moment there is no discernible trend from YR1 to YR2 which can be attributed to rehabilitation.

Table 2.8.5: 2022 – Monitoring YR2 Pollinator Survey Results

Species	May	June	July	August	September	Total
Common Blue *Polyommatus icarus*	0	0	4	1	0	5
Green-veined White *Pieris napi*	0	0	0	0	1	1
Meadow Brown *Maniola jurtina*	5	1	6	3	0	15
Ringlet *Aphantopus hyperantus*	9	0	5	1	0	15
Small Copper *Lycaena phlaeas*	0	2	0	0	0	2
Small Tortoiseshell *Aglais urticae*	0	0	3	1	3	7
Speckled Wood *Pararge aegeria*	0	1	0	0	1	2
Total	14	4	18	6	5	**47**

2.8.3 Surface Water Quality

Oughter bog has one treated surface water outlet to the Pollagh Stream which then flows to the Brosna river IE_SH_25B090761. This outlet is monitored as part of EDRRS (SW18). The location of this outlet is shown on Drawing No. BNM-DR-22-08-32 in Appendix I0.

An analysis of the IPC licence environmental monitoring of some of the discharges from this bog, indicate that recommended parameters like Suspended Solids show an average of 4.5 mg/l and Ammonia an average of 0.324 mg/l, as per results below.

Table 2.8.6: Oughter Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
Oughter	SW-18	Q3 19	10/09/2019	7.1	<2	424	0.188	<0.05	36	110
Oughter	SW-18	Q4 17	13/12/2017	7.4	8	288	0.46	0.05	64	223

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 20 sampling events for this report, up to August 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 3.3mg/l. Similarly, Ammonia had an average of .128 mg/l, which is less than when the bog was in active production and overall trends for the two parameters showed an improving trajectory.

Oughter rehabilitation commenced in July 2021 and since then overall water quality trends are showing an improvement with an obvious lagging relationship between rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

The pH readings can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where

the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.6.

Surface water monitoring for the period and associate graphs are in Appendix I3.

2.8.4 Archaeology

Oughter Bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, there are no known items of archaeological heritage in the rehabilitation area.

2.8.5 Aerial Imagery / LiDAR

Oughter Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Oughter Bog was carried out in July 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.9 Pollagh Bog

Pollagh Bog is located adjacent to the village of Pollagh in County Offaly and to the south of the Grand Canal. The area of the bog is 304 hectares. Pollagh Bog was originally developed for peat production in the 1950's with industrial peat production ceasing in 2019. Further information on the bog is available in the Pollagh Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on Pollagh Bog in May 2021 and was 93% complete at the end of June 2022.

2.9.1 Hydrological Monitoring

Hydrological monitoring is Hydrological monitoring is ongoing at Pollagh Bog. A total of 12 Phreatic wells have been installed, where 5 Phreatic wells have been instrumented with automated loggers. Refer to Drawing No. BNM-DR-22-03-32 for the location of these wells. A total of four monitoring visits have been carried out to date at Pollagh Bog as outlined in Appendix J1 - Pollagh Bog - Hydrological Monitoring, completed in May 2021, July 2021, January 2022 and August 2022. Monitoring will be ongoing at Pollagh Bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works on Pollagh Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed on Pollagh Bog. It is envisaged that completion of these measures will have an impact on ground water levels generally.

A summary of manual readings is provided in Table J1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were lower in summer 2022 than summer 2021 at most wells that were dipped. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data collected from monitoring well PO_012_S demonstrates a relatively deep water table throughout summer 2021, with water levels dropping to 48cm below ground surface, before rising over the autumn and winter period. During Summer 2022

water levels continue to drop to similar levels despite implementation of rehabilitation measures (WLT2). More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

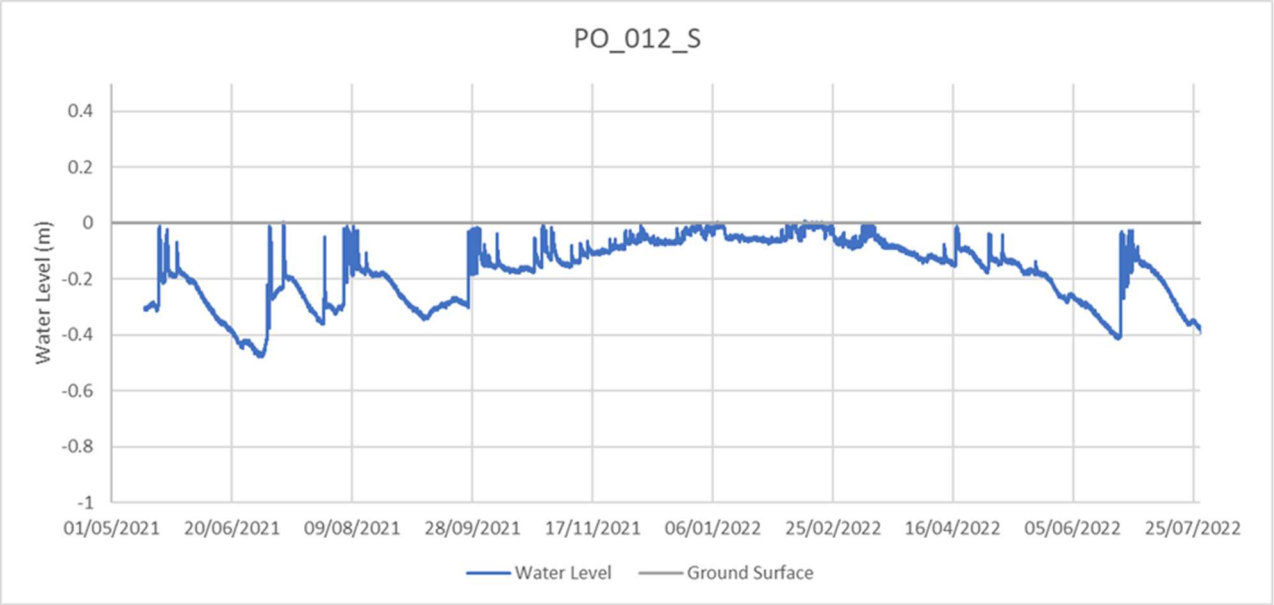

Figure 2.9.1: Hydrograph for monitoring well OT_010s

2.9.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Pollagh Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Pollagh Bog was drained and developed for industrial peat production in the 1950s. The majority of the former peat extraction footprint is bare peat (~75%) with some pockets of developing pioneer habitats (see drone image pre-rehabilitation below). The bog had partially pumped drainage system.

A small area of revegetating cutaway bog, located within the north-west corner of the site and extending along the northern boundary, supports fen vegetation dominated by the community 'Pioneer *Eriophorum angustifolium* community (poor fen)'(pEang) in occurrence with '*Molinia caerula*-dominated community' (gMol), 'Emergent *Betula*-dominated community' (A) (eBir) and 'Dry *Calluna* community' (dHeath). *Carex pseudocyperus* was recorded within a number of drains within this part of the site during habitat surveys in 2021. In this part of the site, some of the cutaway vegetation is relatively wet and there are some pools within the open Birch scrub. *Calliergonella cuspidata* dominates the moss flora in the wetter area and the drier areas have typical species such as

Polytrichum juniperum, Polytrichum commune, Campylopus introflexus and *Rhytidiadelphus squarrosus*. Some of the drier poor fen also has frequent grass cover with Creeping Bent (*Agrostis stolonifera*) and Cocksfoot (*Dactylis glomerata*).

Much of the centre and south of the site is almost entirely re-wetted bare peat ('Bare peat (0-50% cover' or BP), with some sparse establishment of *Triglochin palustre* (pTrig) and pioneer *Eriophorum angustifolium* (pEang) vegetation communities, along with shallow surface water see drone image below.

Part of the north of the site has revegetated with pioneering birch scrub 'Emergent *Betula*-dominated community (A)' (eBir), along with some grassland categorised as '*Anthoxanthum-Holcus-Equisetum* community' (gAn-H-Eq). Some of the small wetlands 'have begun to develop supporting pioneering communities including 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang) and '*Carex rostrata* community' (pRos) along with some scattered *Betula pubescens* and *Juncus effusus.*

Rehabilitation was carried out at this Bog in 2021. It is too soon for habitats at Pollagh to reflect post rehabilitation change or vegetation succession. Almost no new pioneering vegetation is present within the bare peat areas in the rehabilitation extent. The habitats will continue to develop post rehabilitation. In conclusion the habitats recorded in 2021 and 2022 largely reflect the baseline status of a recently transformed peat extraction site. The rehabilitation measures that have re-wetted that site will encourage the continued development of fen and wetland pioneer vegetation at this site.

Figure 2.9.2: Drone image showing example of extensive bare peat.

Figure 2.9.3: Example of pioneering habitats.

Figure 2.9.4: Example of establishing wetland vegetation.

Figure 2.9.5: Example of *Carex pseudocyperus*

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Pollagh bog in June 2021 in accordance with agreed scheme Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Quadrats Q1 and Q3 were dominated by bare peat (90-100% cover), with few plants recorded. See Table 1 of Appendix J2 for further information.

Quadrat Q2 was located in an area of revegetating shallow peat and has been out of production for a few years and consequently, this area supported a greater cover and diversity of plant species, although significant coverage of bare peat remains (34-50%). Colonising species comprised mainly of species such as Colts foot, Yorkshire fog, Cat's ear and Field horsetail.

Quadrats Q4 and Q5 were taken in an area of pioneering habitats comprising of a mosaic of poor fen and establishing scrub. Ground cover was dominated by *Eriophorum angustifolium* and *Molinia caerulea*, with some heather. In addition, scattered *Betula pubescens* scrub in becoming established in this area.

Discussion

As with habitats the quadrats reflect the current baseline conditions following rehabilitation. Further time is required before any vegetation is likely to be recorded.

Figure 2.9.6: Quadrat Q3

Figure 2.9.7: Quadrat Q4

Winter Birds – Monitoring YR1

Method

Counts were carried out at monthly intervals in the period September 2021 to March 2022 inclusive (7 no. in total) and generally spanned the period from 10:00am to 04:00pm.

Constraints

No disturbance events were noted. All counts were carried out in conditions generally good for recording water birds however visibility was considered poor during the February 2022 visit.

Results – Species Richness

A total of five water bird species were recorded across all surveys. One of these were BOCCI (Gilbert *et al.* 2021) Red listed species namely Golden Plover. Two Amber listed species were recorded namely Mallard and Lapwing.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 1 and was highest for Whooper Swan (n=22) and a peak of 60 was present in November of 2021. Whooper Swan was present on 4 of 7 no. counts. Mean abundance was second highest for Mallard (n=3) and 15 were present in October of 2021.

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Pollagh Bog. Mallard and Whooper Swan were associated with water bodies onsite, and Golden Plover associated with extant areas of bare peat

Discussion

Overall water bird species richness was considered very low during the current study period. Similarly, abundance was low (i.e. no mean exceeded 5 individuals) except for Whooper Swan. Previous studies in the winter of 2020/21, to inform Appropriate Assessment reporting for the scheme (Derwin, 2021) additionally recorded 4 other water bird species namely Kingfisher (Amber listed), Lesser black-backed Gull (Amber listed) , Snipe (Red listed) and Woodcock (Red listed). It is possible that the assemblage of wintering water birds varies from year to year at Pollagh and further studies will no doubt be beneficial. We would note that Lapwing was only recorded onsite in March and that these may in fact have been early arriving breeders as some display was noted. Nonetheless the data presented here suggests a rehabilitated Pollagh may act as a refugium for water bird species of conservation concern during both winter and the period immediately prior to breeding. No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far at Pollagh, but rehabilitation measures have consolidated conditions for wetland habitat to develop to support wintering bird species already using the site.

Table 2.9.1: Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	Mean	Max.
GP Golden Plover *Pluvialis apricaria*	Red	0	0	0	0	0	5	0	1	5

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	Mean	Max.
H. Grey Heron *Ardea cinerea*	Green	3	2	2	0	0	1	0	1	3
L. Lapwing *Vanellus vanellus*	Red	0	0	0	0	0	0	5	1	5
MA Mallard *Anas platyrhynchos*	Amber	0	15	3	0	0	0	0	3	15
WS Whooper Swan *Cygnus cygnus*	Amber	0	0	60	30	12	30	0	22	60

Breeding Birds – Monitoring YR1

Methods

No bespoke breeding bird survey transects were carried out at Pollagh Bog. However, an Ecological Restriction Zone was established at the site to avoid disturbance to breeding birds and this was monitored over the period April – June by an ecologist. Breeding bird data from these visits in presented here. In addition, a breeding bird list was compiled in July of 2020 to inform rehab planning, information from this survey is presented as supplementary data.

Constraints

There were no constraints noted for the surveys described in this section.

Results- Species Richness

Two species were recorded in 2022 namely Lapwing (BOCCI Red listed) and Mallard (BOCCI Amber listed). In July of 2020, 'chipping' (considered equivalent of breeding season song) Snipe (*Gallinago gallinago* – BOCCI Red listed *)* were recorded at 2 no. locations on a walkover survey to inform Rehab planning; other species utilising the bog were Grey Heron (*Ardea cinerea*), Mallard (*Anas platyrhynchos*- Amber listed), Skylark (*Alauda arvensis*- Amber listed) (recorded in song on pioneering cutaway therefore considered a likely breeder); and Common Kestrel (*Falco tinnunculus*) (Amber listed) was also noted hunting.

Results – Annual Relative Abundance

Relative abundance during the 2022 survey period was highest for Mallard (n=5) followed by Lapwing (n=4).

Results – Habitat Associations

Both species recorded in 2022 were associating with open habitats on site. In 2020 (pre rehabilitation) several species were recorded associating with pioneering habitats on site. Skylark (Amber listed) were recorded in song from an area of pioneering grassland dominated with *Juncus effusus.*

Results – Colonial Species

No colonial species were recorded.

Discussion

General species richness and abundance is low based on the survey data presented here. It is notable that the two species recorded are both of Conservation concern and associate with open habitats. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009) and is reflected at Pollagh despite the low numbers of species. Regarding breeding waders, up to 2 pairs of Lapwing were likely to have bred at the site and had been present since at least March of 2022 when up to 5 individuals were present and recorded in display on a winter period visit.

It is clear that Pollagh has potential to hold Red listed breeding species such as Lapwing and Snipe along with Amber listed species including Skylark and Mallard. Kingfisher has also previously been recorded at the site along the Pollagh stream and breeding by this species should not be excluded either. It is hoped that post rehabilitation, Pollagh will continue to provide important habitat for species of conservation concern. No significant change in breeding bird species richness and abundance, based on YR1 (2022) data, can be attributed to the peatland rehabilitation so far at Pollagh, and indeed species richness was lower in 2022 than 2020 (although the varying survey effort perhaps makes these incomparable). Nonetheless measures have consolidated conditions for fen and wetland habitat to continue to develop to support breeding bird species already using the site.

Table 2.9.2: 2022 – Monitoring YR1 Breeding Bird Data

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
L. Lapwing *Vanellus vanellus*	Red	OPEN	4
MA Mallard *Anas platyrhynchos*	Amber	OPEN	5

Pollinators

No Pollinator surveys were scoped as part of agreed Monitoring and Verification at Pollagh Bog.

2.9.3 Surface Water Quality

Pollagh Bog has two surface water treated outlets, to the Derrycooley Stream IE_SH_25D130400 DERRYCOOLY STREAM_010 water body which is a tributary of the Brosna, and one other discharge point to the Brosna river IE_SH_25B090761 via IE_SH_25P050300. Both outlets are monitored as part of EDRRS (SW17 & SW 17A) and the location of these outlets are shown on Drawing No. BNM-DR-22-03-32 in Appendix J0.

An analysis over the past 4 years of the IPC licence environmental monitoring of some of the discharges from this bog, indicates that recommended parameters such as Suspended solids averaged 8.1 mg/l with Ammonia averaging 0.56 mg/l, as per results below.

Table 2.9.3: Pollagh Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
Pollagh	S-17A	Q3 20	17/08/2020	8.2	5	423	0.124	<0.05	23	73.9
Pollagh	SW-17	Q3 20	17/08/2020	7.7	20	475	0.241	<0.05	11	72.1
Pollagh	SW-17	Q3 19	02/09/2019	7.6	4	484	0.646	<0.05	26	95.8
Pollagh	SW-17A	Q3 19	02/09/2019	8.2	10	476	0.117	<0.05	15	84
Pollagh	SW-17	Q4 17	13/12/2017	7	5	212	1.9	0.05	63	231
Pollagh	SW-17A	Q4 17	13/12/2017	7.4	5	374	0.34	0.05	67	169

Monthly EDRRS baseline monitoring commenced in August 2020, which gave 25 sampling events for this report, up to August 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with 6.2 mg/l (SW17) and 6.8 mg/l (SW 17A). Similarly, Ammonia had an average of 0.233 mg/l, which is less than when the bog was in active production, and with a slight reducing concentration at SW17 but remaining the same at SW17A.

Pollagh rehabilitation commenced in May 2021 and since then overall trends remained largely unchanged during the period with a lagging relationship between rainfall and concentration of run-off at these locations. During this period with significant drain blocking and cell formation, there was one noticeable peak in suspended solids in March 2022 of 27mg/l, which was 2mg/l the following month.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.8.

Surface water monitoring for the period and associate graphs are in appendix J3

2.9.4 Archaeology

This bog was included in the National Monuments Service archaeological monitoring programme. This was carried out by Archaeological Management Solutions (AMS). Pollagh Bog, Co. Offaly was visited on six occasions during the rehabilitation works (12 August 2021, 16 September 2021, 14 October 2021, 25 November 2021, 13 January 2022, and 25 January 2022). The primary purpose was to monitor the ongoing rehabilitation works including cell formation and drain blocking and to inspect the peat fields and drain sections across the bog for any possible archaeological features. Conditions under foot varied from dry and stable from August to October but gradually became wetter and softer from November to January resulting in raised water levels in many of the cells and drains. Drainage pipes were subsequently placed in the berms of existing cells throughout the bog to insure a water level beneficial to sphagnum moss growth. No new archaeological features of significance were recorded.

No archaeological finds were found and reported during the rehabilitation measures.

During the initial Archaeological Impact Assessment desk study, there were no known items of archaeological heritage located in the rehabilitation area.

2.9.5 Aerial Imagery / LiDAR

Pollagh Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Pollagh Bog was carried out in July 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.10 Turraun Bog

Turraun Bog is located in Co. Offaly, circa 5.5km the south-east of Ferbane. The area of the bog is 541 hectares. Part of Turraun was developed for wetlands and amenity as part of the Lough Boora Discovery Park in the 1990s. Turraun Bog was originally drained and developed for industrial peat production in the 1940s. Industrial peat production ceased in 2018. Further information on the bog is available in the Turraun Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on Turraun Bog in July 2022 and was 95% complete at the end of June 2022.

2.10.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Turraun Bog. A total of 13 Phreatic wells have been installed, where 6 Phreatic wells have been instrumented with automated loggers. Refer to Drawing No. BNM-22-09-32 in Appendix K0 for the location of these wells. A total of four monitoring visits have been carried out to date at Turraun Bog as outlined in Appendix K1 - Turraun Bog - Hydrological Monitoring, completed in May 2021, July 2021, January 2022 and August 2022. Monitoring will be ongoing at Turraun Bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works on Turraun Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed on Turraun Bog. It is envisaged that completion of these measures will have an impact on ground water levels generally.

A summary of manual readings is provided in Table K1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were similar in summer 2022 when compared to summer 2021, with a higher water table in summer 2022 at a small number of locations. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data gathered from well TU_001_S shows the water levels were typically between 20-40cm below ground level throughout summer 2021, before a sharp increase in water level in early October 2021. While water levels were typically 20-30cm below ground level throughout winter 2021/22, water levels remained slightly higher throughout summer 2022, although did decline to 40cm below ground level at the end of July 2022. This monitoring well is located within an area where WLT4 measures were implemented suggesting limited interventions, which may explain the limited response. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

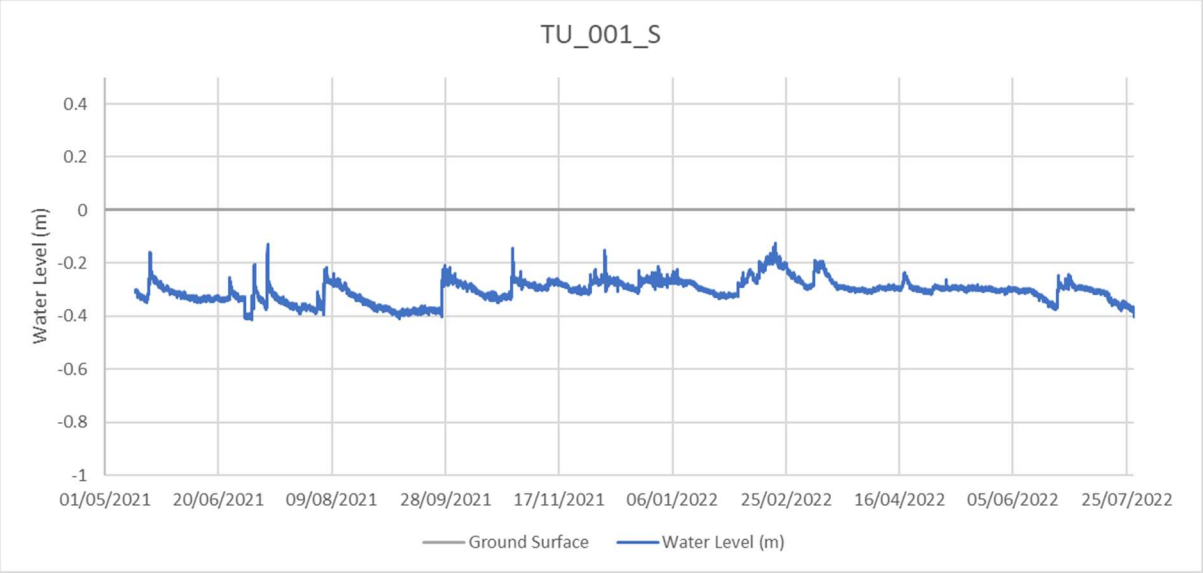

Figure 2.10.1: Hydrograph for monitoring well TU_005s

2.10.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Turraun Bog in 2022.

Constraints

There were no constraints noted for the surveys described in this section.

Results

Turraun can be divided into four main sections; the southern section of pioneering cutaway bog, the central section that was in active production until recent years, the northern section that has been cutaway for some time and is part of the Lough Boora Discovery Park (LBDP), and the small area west of the local road in the west of the site. The most intensive rehabilitation measures were applied to those areas in recent peat extraction, while targeted measures were used in other areas to improve re-wetting across the site.

The central part of Turraun is dominated by bare peat ('Bare peat (0-50%cover)' or BP) and is developing associated pioneer habitats. Cutaway habitats dominated by communities such as 'Dry *Calluna* community' (dHeath) and 'Closed *Betula* scrub community (C)' (cBir) are developing on high fields while pioneer poor fen habitat dominated by the community 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang) is developing in wetter or low-lying areas. Re-wetting measures have re-wetted some bare peat and created some shallow water in some sections.

In the south of the bog a substantial area is developing into a mosaic of habitats through natural regeneration. Pioneer wetland communities dominated by '*Phragmites australis* community' (pPhrag) and '*Typha* community' (pTyp) are developing in some areas. '*Eriophorum angustifolium* community (poor fen)' (pEang) and 'Pioneer *Juncus effusus* community' (pJeff) poor fen communities are also

developing in parts of this section. A small portion of this section remains as Bare peat. In Winter, large bodies of open water ('Temporary open water' or tOW) can be found in the low-lying areas in this section. Part of the bog south of the railway is also developing in a similar fashion and re-wetting with a mosaic of small open water bodies, pioneer fen and bare peat habitats.

An area in the north of Turraun has been managed for biodiversity and amenity since 2000s and is part of the LBDP. Turraun lake and wetlands were created by blocking drains and the construction of a berm around a natural basin in the early 1990's, providing extensive reedbeds and pioneer fen habitat. As a result, the community '*Betula-Salix* woodland' (BirWD) (WN7) dominates the area to the immediate east of the wetland, much of which has been in development for over 30-40 years. The majority of the woodland understory is dominated by *Rubus fructicosus* scrub and remains dry. However small patches are wet, have high *Sphagnum* cover and have the potential to develop into habitat that could be classified as Annex I bog woodland in the future. Some minor targeted drain-blocking was carried out in the area.

The grassland community 'Dry calcareous grassland' (gCal) has developed further east across the northern section of the site (Cocta Hill), formed on a glacial ridge on exposed glacial subsoil and shallow peat. This grassland is a feature of high biodiversity value due to its flora. It is orchid-rich and contains scarce and rare species such as Blue Fleabane and Field Gentian. Dry *Calluna* (dHeath), closed *Betula* scrub (cBir) and dense *Pteridium* (dPter) communities can also be found on Cocta Hill. To the east of the ridge, a Native Woodland Scheme plantation of Scots, Pine and Pedunculate Oak was established by Bord na Móna. No rehabilitation was carried out in this area.

To the west of the road that runs through Turraun there is a small Coillte commercial forestry plantation (WD4), a small band of improved grassland (GA1), and the Bord na Móna community 'Dry calcareous grassland'(gCal) is developing on the gravel used to support the former railway, two small artificial lakes ('Permanent pools and lakes' or OW) and some areas of bare peat ('Bare peat (0-50% cover)' or BP). An amenity car-parking facility is located at the south-west corner of the site. A community of maturing '*Betula-Salix* woodland' (BirWD) has developed on a low-lying section of cutaway bog. No EDRRS measures were carried out in this section.

Discussion

It is too soon for habitats in the recently re-wetted areas at Turraun to reflect post rehabilitation change or vegetation succession. Some initial rewetting and new wetlands with shallow surface water have been noted post the implementation of the EDRRS measures. These measures have the potential to result in the develop of more extensive wetland habitats with fen, Reedbeds and wet woodland similar to those already established within the site.

Some areas of the bog already have well established vegetation including Reedbeds, fen, scrub and woodland. The habitats already present are expected to continue to develop and change with time. Where rehabilitation works have been implemented within areas of established scrub/pioneering woodland it is anticipated that these habitats will develop wetter ground conditions.

In conclusion the habitats recorded in 2022 largely reflect the baseline status of the bog.

Figure 2.10.2: Example of recolonising shallow bare peat.

Figure 2.10.3: Example of recolonising bare peat.

Figure 2.10.4: Established wetland and Turraun lake.

Figure 2.10.5: Established birch dominated woodland.

Vegetation Quadrats – Monitoring YR1

Vegetation quadrats are not included in the scheme monitoring scope for Turraun Bog.

Winter Birds – Monitoring YR1

Method

Fixed counts, following I-WeBS methods, were used to count wintering waterfowl at Turraun. A total of seven counts were undertaken, at monthly intervals, covering the period September 2021 to March 2022 inclusive.

Constraints

There are three established suitable wetlands occurring at Turraun bog comprising of one large lake and associated wetland and two smaller lakes. Some parts of the large wetland can be difficult to survey due to the extensive reedbeds and poor fen occurring to the north east which is largely inaccessible. As these features can provide shelter for some wintering wildfowl and waders, it is likely that some species have been under recorded, in particular Water rail and Snipe. However, regularly occurring wildfowl such as swans, geese and duck are all relatively easy to survey at these wetlands.

Results – Species Richness

A total of 17 water bird species were recorded across all four surveys.

Snipe, Curlew, Lapwing and Wigeon are all BOCCI Red listed species (Gilbert *et al.* 2021). 10 Amber listed species were recorded, namely Teal, Whooper Swan, Mute Swan, Black-headed Gull Little Egret, Greylag Goose, Mallard and Ringed Plover. Good numbers of Greylag Goose, Mallard, Wigeon and Whooper Swan were recorded throughout the core winter months, indicating that this site is likely to regularly support these species.

Low but constant numbers of Mute swan were recorded. Teal, Grey Heron, Lapwing, Snipe and Water Rail were each recorded in low numbers and often on only one survey date. This suggests that these species are likely to use the site intermittently during the winter months or in low numbers. Species such as Snipe and Water rail are often difficult to accurately count due to the fact that they are often recorded by flushing (Snipe) or by vocalisations (Water rail).

Whooper swan was recorded during all visits with a peak count of 136 in February 2022. This indicates that the species uses the wetlands at Turraun (typically the largest of the three lakes) during the core winter months, while likely also foraging in the wider landscape. The species is known to regularly use the largest of the lakes as a night roost.

Results – Abundance

The total counts for each visit across the winter period is presented in Table 2.10.1. It is clear that the site is only used intermittently by some wintering waterfowl species while other species occur throughout the core winter months. However, given the nature of the wetland occurring at Turraun, often difficult to survey due to the extensive reedbeds located to the east of the largest of the three lakes, it is likely that some species have been under recorded (Water Rail or Snipe for example). Abundance was highest for Whooper Swan with a maximum of 136 recorded, which approaches the All Ireland threshold for National Importance of 150.

Results – Habitat Associations

Most of the wintering wildfowl records were associated with the largest of the three lakes within the northwest of the bog. This, the largest wetland, was regularly used by duck and swan species as and it is likely that the established reedbeds and associated aquatic vegetation support greater invertebrate and vegetative feeding opportunities. In addition, the large open waterbody provides greater protection from predators.

Discussion

Overall species richness is considered high for the period studied. This reflects the current baseline bog condition, with much of the large wetland supporting established reedbeds and some fringe and aquatic plant vegetation. This provides foraging opportunities for many species of water bird. The largest of the three waterbodies provide suitable roosting locations for wintering waterbirds, particularly Whooper Swan which can occur in numbers close to National Importance. Greylag Geese which occur at Turraun are considered feral rather than individuals from the migratory Icelandic population. Over time, as supporting wetland vegetation extends and develop at Turraun it is expected that other new wetland habitats may also become important for a greater diversity and increasing numbers of wintering wildfowl species such as those recorded during the 2021-22 winter months. Post rehabilitation and associated revegetation, these waterbodies and other areas within Turraun bog may contribute to further habitat for a variety of wintering bird species of conservation concern occurring in the wider landscape. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds. No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far at Turraun, but measures have consolidated conditions for wetland habitat to continue to develop to support wintering bird species already using the site.

Table 2.10.1: Winter 2021/22 – Monitoring YR1 I-WeBS Survey Results

Species	BOCCI STATUS	SEP	OCT	NOV	DEC	JAN	FEB	MAR	Mean	Max
WS Whooper Swan *Cygnus cygnus*	Amber	0	15	10	19	27	136	0	41	136
MA Mallard *Anas platyrhynchos*	Amber	50	4	12	6	4	0	3	13	50
GJ Greylag Goose *Anser anser*	Amber	0	5	4	0	17	40	0	17	40
BH Black-headed Gull *Chroicocephalus ridibundus*	Amber	0	0	0	1	0	0	0	1	1
MS Mute Swan *Cygnus olor*	Amber	0	2	0	5	4	0	8	5	8
T. Teal *Anas crecca*	Amber	0	0	4	0	0	0	0	4	4
BH Black-headed Gull *Chroicocephalus ridibundus*	Amber	0	0	0	0	0	0	3	3	3
RP Ringed Plover *Charadrius hiaticula*	Amber	0	0	0	0	0	0	1	1	1
H. Grey Heron *Ardea cinerea*	Green	2	2	0	0	1	0	0	2	2
LG Little Grebe *Tachybaptus ruficollis*	Green	1	2	0	0	0	0	0	2	2
MH Moorhen *Gallinula chloropus*	Green	2	3	0	1	0	0	3	3	3
WA WaterRail *Rallus aquaticus*	Green	0	3	0	2	0	0	0	3	3
ET Little Egret *Egretta garzetta*	Green	0	1	1	0	1	0	0	1	1
HW Great White *Egret Ardea alba*	NA	0	0	0	2	0	0	0	2	2
L. Lapwing *Vanellus vanellus*	Red	0	19	0	0	0	0	2	11	19
SN Snipe *Gallinago gallinago*	Red	0	0	0	1	0	0	1	1	1
WK Woodcock *Scolopax rusticola*	Red	0	0	0	2	0	0	0	2	2

Breeding Birds – Monitoring YR1

Methods

At Turraun, two 500 metre transects were selected to provide a representative sample of the breeding bird community. Each transect was placed along an existing high field or headland for ease of use but also because these locations will continue to be accessible post rehabilitation, allowing the same route to be repeated. Two visits, one in May and one in July of 2022, were carried out. See the figure titled '*Turraun Bog Ecology Transects'* for transect location information.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, headlands or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to transect routes i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am-11:00am). CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to

extend this period for sites which require longer travel times or where access is difficult. The timing of some visits may have exceeded the CBS recommended period for surveying but were complete by 11:00am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant. In addition, the second CBS visit took place on July 14th, 2022, which is outside the recommended CBS survey period. The ARA presented herein only includes observations during the period April to June inclusive (in line with the overall approach) and a cautionary approach is taken in assigning breeding status to birds recorded in July only (JO).

Results- Species Richness

Species richness is presented as the total number of species recorded across transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 42 no. species were recorded, see Table 2.10.2. This included five BOCCI (Gilbert *et al.* 2021) Red listed species, Black-headed Gull, Lapwing, Meadow Pipit, Snipe and Swift. Seven BoCCI Amber listed species namely, Goldcrest, Linnet, Skylark, Mallard, Water Rail (JO), Swallow and Willow Warbler. Remaining species were all Green listed apart from Pheasant [redacted] which is not assigned a BoCCI status. Although no dedicated breeding waders survey was undertaken, based on observations during the CBS survey, Lapwing and Ringed Plover were both recorded on CBS transects, and based on observations during the CBS survey, at least 1 pair of Lapwing and 1 pair of Ringed Plover were noted as having bred onsite in 2022.

Results – Annual Relative Abundance

Annual Relative Abundance (ARA) is presented as the maximum count per species per visit (Early or Late) or as the maximum count for the period May to July inclusive, see Table 210.2. This allows for future comparison with CBS trends which takes the same approach to index species.
Maximum counts of greater than 10 individuals were recorded for 16 species, including one flock of 300 Rook. As these were recorded in flight so are more likely to be associated with surrounding farmland. Good numbers of Redpoll were also noted at the site, see Table 2.10.2. All remaining species were recorded in low numbers (<10). The passerine species with the highest relative abundance (n=19) associating with cutover/open habitats was Meadow pipit.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Twenty-three species considered associated with OPEN habitats were recorded and eighteen species associated with NON-OPEN habitats were recorded see Table 2.10.2. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were recorded.

Discussion

It is notable that the four Red listed species recorded, Black-headed Gull, Lapwing, Meadow Pipit and Snipe are associated with open habitats targeted for rehabilitation in the form of rewetting, and would be expected to gain from many of the measures implemented (wetland creation and fertiliser application to high fields for example). Only one observation of two Black-headed Gulls was made and it is therefore assumed that the species did not breed within proximity to the CBS transect. The Red listed species, Meadow Pipit associates with drier open habitats and was commonly recorded across the site. Although recorded in July only, the Amber listed Water Rail is considered a likely breeder given the habitats on site are highly suitable. Overall, the total number of species either Red or Amber listed was 13.

In general, the abundance estimates reflect the expansive bare peat and the marginal habitats currently present at Turraun. For instance, species such as Robin, Blackbird and Willow Warbler are more likely to associate with marginal unrehabilitated habitats. Abundance is generally low for most species with open habitat associations. However, the current bare peat extent limits foraging and breeding opportunities for many of these. [redacted]

Regarding habitat associations 55% of species recorded are more associated with open habitats. Open habitat species comprise 11 no. of the 13 Red and Amber listed species recorded, with only two either Red or Amber species associated with non-open habitats (Goldcrest and Willow Warbler). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case. Further analysis on trends in the ratio or relative abundance of these species over time following rehabilitation would be beneficial.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds. No significant change in breeding bird species richness and abundance can be attributed to the peatland rehabilitation so far at Turraun, but measures have consolidated conditions for fen and wetland habitat to continue to develop to support breeding bird species already using the site.

Table 2.10.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
[redacted]	N/A	OPEN	1
B. Blackbird *Turdus merula*	Green	NON-OPEN	19
BC Blackcap	Green	NON-OPEN	12
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	2
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	0
BZ Buzzard *Buteo buteo*	Green	OPEN	0
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	15
CK Cuckoo *Cuculus canorus*	Green	OPEN	6
CT Coal Tit *Periparus ater*	Green	NON-OPEN	2
ET Little Egret *Egretta garzetta*	Green	OPEN	0
GC Goldcrest *Regulus regulus*	Amber	NON-OPEN	2
GO Goldfinch *Carduelis carduelis*	Green	OPEN	0
GR Greenfinch *Chloris chloris*	Green	NON-OPEN	2

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
GT Great Tit *Parus major*	Green	NON-OPEN	0
H. Grey Heron *Ardea cinerea*	Green	OPEN	4
HC Hooded Crow *Corvus cornix*	Green	OPEN	0
L. Lapwing *Vanellus vanellus*	Red	OPEN	14
LI Linnet *Carduelis cannabina*	Amber	OPEN	16
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	32
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	2
M Mistle Thrush *Turdus viscivorus*	Green	NON-OPEN	4
MA Mallard *Anas platyrhynchos*	Amber	OPEN	4
MH Moorhen *Gallinula chloropus*	Green	NON-OPEN	0
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	20
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	7
PW Pied Wagtail *Motacilla alba*	Green	OPEN	4
R. Robin *Erithacus rubecula*	Green	NON-OPEN	18
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	14
RO Rook *Corvus frugilegus*	Green	NON-OPEN	300
RP Ringed Plover *Charadrius hiaticula*	Green	OPEN	16
S. Skylark *Alauda arvensis*	Amber	OPEN	16
SC Stonechat *Saxicola rubicola*	Green	OPEN	0
SI Swift *Apus apus*	Red	OPEN	8
SL Swallow *Hirundo rustica*	Amber	OPEN	6
SN Snipe *Gallinago gallinago*	Red	OPEN	5
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	2
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	4
WA Water Rail *Rallus aquaticus*	Amber	OPEN	0
WH Whitethroat *Sylvia communis*	Green	OPEN	14
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	8
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	8
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	17

Pollinators

Pollinators are not included in the scheme monitoring scope for Turraun Bog.

2.10.3 Surface Water Quality

Turraun bog has two surface water treatment outlets to the Pollagh Stream (Brosna) 010 IE_SH_25P050300 and the Boora River IE_SH_25B080100. Both outlets are monitored as part of EDRRS (SW15 &16) and the location of these outlets are shown on Drawing No. BNM- 22-09-32 in Appendix K0.

Analysis of 3 years of the IPC licence environmental monitoring of some of the discharges from this bog, indicates that recommended parameters like Suspended Solids averages 5.1 mg/l and Ammonia averages 0.56 mg/l, as per results below.

Table 2.10.3: Turraun Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS	TS	Ammonia	TP	COD	Colour
Turraun	SW-15	Q3 19	7.7	6	437	0.19	0.05	48	103
Turraun	SW-16	Q3 19	7.5	2	467	0.069	0.05	45	127
Turraun	SW-15	Q4 17	7.3	6	440	0.14	0.05	82	192
Turraun	SW-16	Q4 17	7.4	7	258	0.82	0.05	70	212
Turraun	SW-15	Q2 16	7.8	5	407	0.04	0.11	41	83
Turraun	SW-16	Q2 14	7.2	5	392	2.1	0.05	29	111

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 20 sampling events for this report, up to August 22. During the monitoring period, suspended solids remained well within the associated emission limit value, with 4mg/l (SW 15) and 5.3mg/l (SW16). Similarly, Ammonia had an average of .164 mg/l, which is less than when the bog was in active production and trended flat.

Turraun rehabilitation commenced in July 2021 and since then overall trends remained relatively neutral during the period with no obvious clear relationship between rainfall and concentrations of run-off at this location. During this period with significant drain blocking and cell formation, there was one noticeable peak in suspended solids of 25mg/l which was back down to 2mg/l the following month.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.5.

Surface water monitoring for the period and associate graphs are in Appendix K3.

2.10.4 Archaeology

Turraun Bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. There are no known archaeological sites in the rehabilitation area. Known archaeological finds consist of metal and stone artefacts, bog butter and human remains.

2.10.5 Aerial Imagery / LiDAR

Turraun Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Turraun Bog was carried out in July 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.11 Castlegar Bog

Castlegar Bog is located in east County Galway to the west of the River Suck and the overall area of the bog is 520 hectares. This area includes a section of Annaghbeg Bog National Heritage Area (NHA). No rehabilitation measures were proposed or carried out on Annaghbeg Bog as there has been no Bord na Mona drainage, bog development or industrial peat production in this area. The remainder of bog was drained and developed for industrial peat production in the 1990s and was in active peat production since 2004. Industrial peat production permanently ceased in 2019. The site is located adjacent to the River Suck and several designated sites. Further information on the bog is available in the Castlegar Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021.

Castlegar Bog was a trial site for various rehabilitation measures and these trials commenced in Summer 2020. The rehabilitation of the bog was 88% complete at the end June 2022.

2.11.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Castlegar bog. A total of 40 piezometer nests have been installed comprised of 37 deep wells, 40 Phreatic wells which have been instrumented with automated loggers, with a subset of the deep piezometers (6) instrumented with automated loggers. Refer to Drawing No. BNM-DR-22-01-32 in Appendix L0 for the locations of these wells. A total of three monitoring visits have been carried out to date at Castlegar bog as outlined in Appendix L1 - Castlegar Bog - Hydrological Monitoring, with manual dipping completed in August 2021, January 2022, and logger dipping in August 2022. Monitoring will be ongoing at Castlegar bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix L1. Overall, there is a broad trend of a higher summer water table in Summer 2022 compared to Summer 2021. There are some exceptions where the water table in summer 2022 was deeper than 2021; however, it is important to note that in some areas of the bog, rehabilitation works had already commenced in 2021, therefore, the readings are not necessarily baseline readings. Furthermore, a single manual reading at a point in time does not consider the different in weather conditions leading up to the monitoring taking place. Monitoring took place at Castlegar in August 2022 which was after a prolonged dry spell. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

Analysis of logger data provides a more robust means of assessing monitoring data. A number of typical examples of logger data are presented below. Well CG_036s is located in an area targeted for Deep peat measures (DTP3-), the data illustrates a deep water table, even during winter months with maximum water levels of >600mm below ground surface. Following implementation of measures in October 2021 in this area, the water table rises rapidly, with the cell filling up over winter months. Water levels do decline during summer months to c. 300mm below ground surface, but there is an obvious change in the hydrological regime at this location. This is a very positive result given the extremely dry Spring and Summer of 2022.

A similar trend is observed at CG_033s which is a location where cell bunding was implemented (DPT5). The measure has been extremely successful with baseline maximum water table depth of >800mm below ground surface. Following bunding in Autumn 2021, water levels risk rapidly, with water levels clearly too high (up to 400mm above ground surface). Channels were then installed in

April 2022 to manage water levels. Despite a very dry summer, the water table in summer 2022 remains within 220mm of the ground surface at all times.

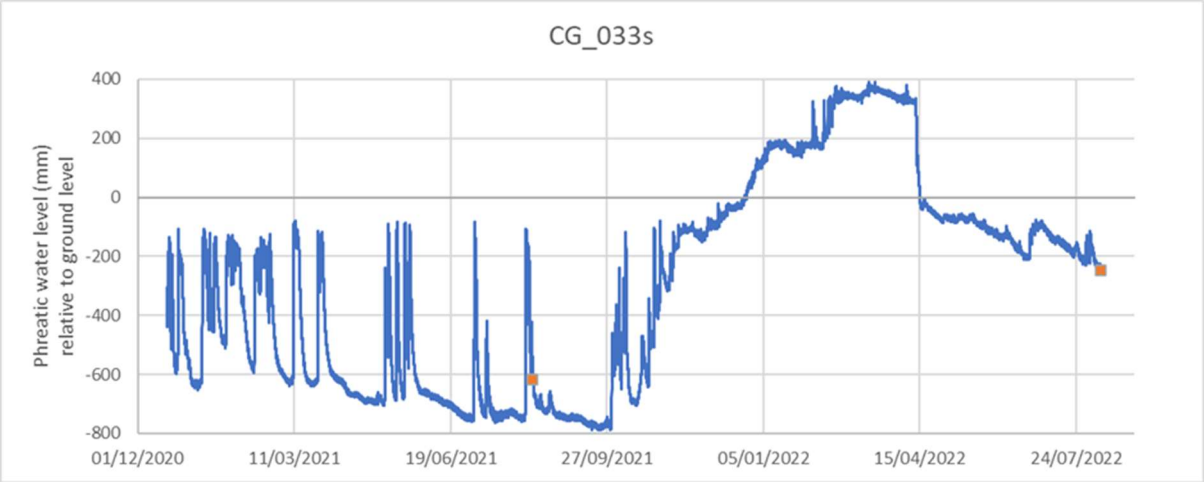

Figure 2.11.1: Hydrograph for monitoring well CG_036s

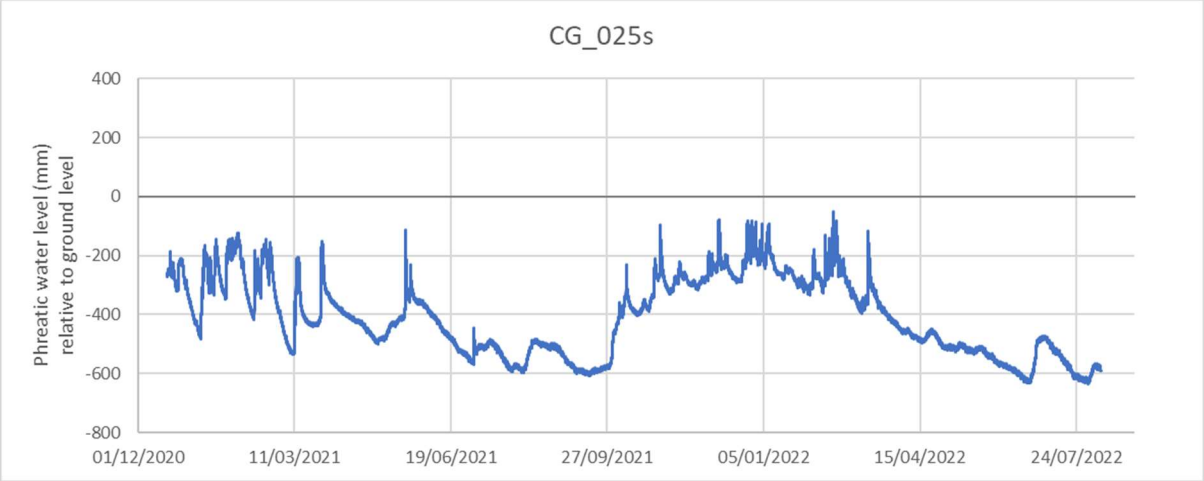

Figure 2.11.2: Hydrograph for monitoring well CG_025s

2.11.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Castlegar Bog during summer 2022.

Constraints

At the time of survey much of the bare peat at Castlegar has been rehabilitated to form bunded cells. Many of these areas are not safe for pedestrian access due to standing water or soft conditions and must be avoided. This is not thought to have affected survey results however as there are still high fields present which can be used for access.

Results

Castlegar Bog was drained and developed for industrial peat production in the 1990s and was in active peat production since 2004, ceasing in 2019. The majority of the former peat extraction footprint is bare peat (~75%).

Habitats within the rehabilitated area at Castlegar bog correspond to the Fossitt habitat classification *Cutover bog* (PB4). This is mainly composed of re-wetted bare peat modified with rehabilitation to form bunded cells with blocked drains in some sections, while other sections had a variety of drain-blocking. This work was completed in 2021. Some of the former bare peat has shallow surface water.

There is a small amount of pioneer vegetation developing across the site. Vegetation communities recorded during summer 2022 include 'Bare peat (0-50% cover)' (BP), pioneering open cutaway communities dominated mainly by the classification 'Pioneer *Juncus effusus* community' (pJeff), or 'Dry *Calluna* community' (dHeath) or 'Emergent *Betula*- dominated community' (eBir). There were drains noted in some areas that were colonising with *Sphagnum* moss (see images below), which was present prior to rehabilitation.

It is too soon for habitats at Castlegar to reflect post rehabilitation change or succession. Some colonising *Sphagnum* is present, but *Sphagnum cuspidatum* was noted in marginal drains and some field drains prior to intervention in 2021. Nonetheless this is indicative of suitable conditions for *Sphagnum* growth at the site.

Almost no fresh pioneering vegetation is present so far in the rehabilitation extent (see also Quadrat survey results, below). Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas. A pipe through the centre of the bog has been broken to create a more natural riparian corridor, which in time will result in a change in habitats along its extent. In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of pioneer vegetation cover at this site in the future.

Figure 2.11.3: Photos showing *Sphagnum* mosses in drains at Castlegar 2022

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Castlegar bog during summer of 2022 in accordance with agreed EDRRS Monitoring and Verification.

Constraints

Several quadrats are placed within bunded cells with uneven/soft conditions which were unsuitable for pedestrian access. In this scenario percentage cover of vegetation was observed from the nearest berm or equivalent safe location.

Results

Quadrats Q1 and Q2 were dominated by open water (76-90% cover) with the remainder bare peat. Quadrats Q3 and Q4 were each 100% bare peat. See Table 1 of Appendix L2 for detailed quadrat information.

Discussion

As with habitats the quadrats reflect the current baseline conditions following rehabilitation. Further time is required before any vegetation is likely to be recorded.

Figure 2.11.4: A sample of 2 no. Quadrats at Castlegar in 2022

Winter Birds – Monitoring YR1

Method

Fixed counts, following I-WeBS methods, were used to count wintering waterfowl at Castlegar. A total of six counts were undertaken, at monthly intervals, covering the period September 2021 to February 2022 inclusive.

Constraints

No constraints were noted. In September, some EDRRS activity was still ongoing however this is not considered to have affected the count.

Results – Species Richness

A total of eight water bird species were recorded across all surveys. Three of these were BOCCI (Gilbert *et al.* 2021) Red listed species namely Golden Plover, Snipe and Lapwing. Five Amber listed species were recorded namely Mallard, Teal, Mute Swan, Whooper Swan and Cormorant.

Results – Abundance

Average abundance across the winter period is presented in Table 1 and was highest for Golden Plover (n=26). A peak of 150 was noted for this species in October of 2021 but it is noted the species was present on only two of six counts. Lapwing and Snipe both occurred on five of six counts and Teal occurred on three of six counts. A maximum or peak for Lapwing was recorded in February of 2022 when 77 were present. Snipe numbers never exceeded 8, and a maximum of 47 Teal were present in October of 2021.

Results – Habitat Associations

Most birds across all counts were found to associate with the River Suck and its corridor. Peak counts for Teal (47) and Lapwing (77) for instance both involved birds associating directly with the river and not Castlegar nor the rehabilitation extent. Snipe was found to associate with the bog but this probably reflects its propensity to flush from intact high bog or marginal habitats when approached and on one instance 7 were flushed from bare peat onsite. Mute Swan, Cormorant and Whooper Swan were all recorded in flight over the River Suck. The species which perhaps exhibits the highest association with habitats as presented currently at the site is Golden Plover. In October 150 were recorded in flight near or over the bog and these may utilise the bog for roosting, as 3 were noted on bare peat in the south of Castlegar in December.

Discussion

Overall species richness is considered low during the period studied (6-10 species is below average (n=11) for the 14 bogs where winter surveys were carried out)This reflects the baseline bog condition which is dominated by bare peat which offers little or no foraging opportunities for many species of water bird. Roosting opportunities are provided for two species Lapwing and Snipe, which may also forage onsite. Regarding abundance, species such as Mute Swan and Whooper Swan, which often winter in large numbers at other Bord na Móna bogs (Copland 2009, 2010 and Gittings 2021) were effectively absent and only found to utilise the adjacent corridor of the River Suck in low numbers. Over time, as peatland habitats develop further at Castlegar it is expected that it may also become a

refugium for species such as these during the winter months, as the rate of association with the onsite habitats increases.

It is notable that all species recorded were of Conservation concern. In the context of an adjacent European Site (the River Suck Callows SPA) which has Whooper Swan, Golden Plover , Lapwing and '*Wetland and Waterbirds'* as qualifying interests a post rehabilitation Castlegar may contribute to further habitat for these species and support the conservation objectives for this European Site. Another qualifying interest, Wigeon, along with Mallard and Coot has previously been recorded from a silt pond at Castlegar (JOD Ltd. 2021).

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds at Castlegar. No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far at Castlegar, but measures have consolidated conditions for peatland habitats to continue to develop to support wintering bird species already using the site.

Table 2.11.1: Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Max
SN Snipe *Gallinago*	Red	3	1	7	8	3	0	4	8
MA Mallard *Anas platyrhynchos*	Amber	3	0	0	0	2	6	2	6
GP Golden Plover *Pluvialis apricaria*	Red	0	150	0	3	0	0	26	150
L. Lapwing *Vanellus*	Red	0	12	39	10	7	77	24	77
T. Teal *Anas crecca*	Amber	0	47	20	0	0	0	11	47
MS Mute Swan *Cygnus olor*	Amber	0	0	2	0	0	0	0	2
WS Whooper Swan *Cygnus*	Amber	0	0	0	2	0	0	0	2
CA Cormorant *Phalacrocorax carbo*	Amber	0	0	0	0	2	0	0	2

Breeding Birds – Monitoring YR1

Methods

At Castlegar, three, 1km in length, transects were selected to provide a representative sample of the breeding bird community. In addition, a breeding wader survey was carried out in line with O'Brien & Smith 1992, which comprised walking a predefined route or transect across the bog on each of 4 visits

in the period April to July inclusive. See the figure in Appendix L2 titled '*Castlegar Bog Ecology Transects'* for transect locations.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, headlands or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to transect routes i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10-11am). CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. The timing of some visits may have exceeded the CBS recommended period for surveying (notably visit 1) but were complete by 11:00am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant. Wind was high on one count (visit 2) but is considered to not have affected the results; in addition, a further count was carried out in the April-June period in better conditions.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 33 no. species were recorded, see Table 2.11.2. This included four BOCCI (Gilbert *et al.* 2021) Red listed species, Black headed Gull, Lapwing, Meadow Pipit and Snipe along with five BOCCI Amber listed species namely, Goldcrest, Skylark, Mallard, Swallow and Willow Warbler. Remaining species were all Green listed apart from Pheasant which is not assigned a BOCCI status.

A bespoke breeding waders survey was undertaken, data on wading species recorded is herein presented in line with an interpretation following the O'Brien and Smith 1992 method for censusing lowland breeding wader populations. On this basis 1 pair of Lapwing and 2 pairs of Snipe bred onsite in 2022. The Lapwing nested in the west of the site close to CBS transect 1.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species per visit (E or L) or as the maximum count for the period April to June inclusive, see Table 2.11.2. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 10 individuals were recorded for three species, Rook, Willow Warbler and Meadow pipit. All remaining species were recorded in low numbers (<10). Overall abundance was highest for Rook with a maximum of 25 individuals recorded in the period April to June however these were recorded in flight so are more likely to be associated with surrounding farmland. The species with the highest relative abundance (n=14) associating with cutover habitats was Meadow pipit.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Fifteen species considered associated with OPEN habitats were recorded and eighteen species associated with NON-OPEN habitats were recorded see Table 2.11.2.

Results – Colonial Species

No colonies were recorded.

Discussion

It is notable that the four Red listed species recorded, Black-headed Gull, Lapwing, Meadow Pipit and Snipe are associated with open habitats targeted for rehabilitation in the form of rewetting, and would be expected to gain from many of the measures implemented (wetland creation and fertiliser application to high fields for example) Only a single observation was made of Black headed Gull so it is assumed to not have bred onsite. The Red listed species, Meadow Pipit associates with drier open habitats and had the second highest relative abundance overall or highest overall for species associated with cutover. Overall, the total number of species either Red or Amber listed was 9.

Breeding waders included Snipe (2 pairs) and Lapwing (1 pair). Both are Red listed and breeding numbers may increase over time following rehabilitation.

Relative abundance was highest in 2022 for three species. In general, the abundance estimates reflect the expansive bare peat and the marginal habitats currently present at Castlegar. For instance, both Rook and Willow warbler are more likely to associate with either nearby farmland (in the case of Rook) or marginal unrehabilitated habitats. Abundance is generally low for most species with open habitat associations however the current bare peat extent limits foraging and breeding opportunities for many of these.

Regarding habitat associations 45% of species recorded are more associated with open habitats. Open habitat species comprise a higher proportion of Red and Amber listed species (7 no. in total), with only two either Red or Amber species associated with non-open habitats (Goldcrest and Willow warbler). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case at Castlegar. Further analysis on trends in the ratio or relative abundance of these species over time following rehabilitation would be beneficial. No significant change in breeding bird species richness and abundance can be attributed to the peatland rehabilitation so far at Castlegar, but measures have consolidated conditions for peatland habitats to continue to develop to support breeding bird species already using the site.

Table 2.11.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	6
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	4

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	4
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	1
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	1
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	5
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	3
CK Cuckoo *Cuculus canorus*	Green	OPEN	4
CT Coal tit *Periparus ater*	Green	NON-OPEN	1
D. Dunnock *Prunella modularis*	Green	NON-OPEN	5
GC Goldcrest *Regulus*	Amber	NON-OPEN	1
GO Goldfinch *Carduelis carduelis*	Green	OPEN	1
GT Great Tit *Parus major*	Green	NON-OPEN	2
HC Hooded Crow *Corvus cornix*	Green	OPEN	7
JD Jackdaw *Corvus monedula*	Green	NON-OPEN	6
L. Lapwing *Vanellus*	Red	OPEN	2
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	3
MA Mallard *Anas platyrhynchos*	Amber	OPEN	5
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	14
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	3
PW Pied wagtail *Motacilla alba yarrellii*	Green	OPEN	1
R. Robin *Erithacus rubecula*	Green	NON-OPEN	6
RB Reed bunting *Emberiza schoeniclus*	Green	OPEN	2
RO Rook *Corvus frugilegus*	Green	NON-OPEN	25
S. Skylark *Alauda arvensis*	Amber	OPEN	3
SC Stonechat *Saxicola rubicola*	Green	OPEN	3
SL Swallow *Hirundo rustica*	Amber	OPEN	5
SN Snipe *Gallinago*	Red	OPEN	2
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	1
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	3
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	1
WR Wren *Troglodytes*	Green	OPEN	5
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	14

Pollinators

Methods

A transect (2km in length) was established across part of Castlegar to record pollinators, indicator species (Butterflies) and other taxa where relevant. Pollinator recording followed guidelines set out by the National Biodiversity Bumblebee Monitoring Scheme. A total of 5 visits within the period April 2022 to August 2022 inclusive are herein reported. The transect route is shown in the Figure titled '*Castlegar Bog Ecology Transects'* in Appendix L2.

Constraints

Wind occasionally reached higher than ideal speeds, but this may reflect the open nature of the cutaway and is relatively unavoidable.

Results – Species Richness

A total of five species of butterfly were recorded namely Brimstone, Orange Tip, Peacock, Small White and Speckled Wood. In addition to butterflies, Honeybee *Apis mellifera* (n=6 across all visits) and Bumblebees *Bombus spp.* (n=15 across all visits) were recorded.

Results – Abundance

Speckled Wood and Orange Tip butterflies occurred in the highest abundance (11 overall), however the maximum number per species per visit was for Orange Tip, with 6 recorded in April of 2022. Highest abundance overall per month was for April.

Results – Habitat Associations

In general, little or no pollinator activity was clearly associated with bare peat or recently rehabilitated bare peat areas. Species recorded on bare peat sections of the transect were primarily traversing the transect as insufficient vegetation is present to attract feeding pollinators. In contrast the northern section of the sampling transect, which adjoins the old rail line is already vegetated and this is where a high proportion of pollinators were encountered. Regarding Brimstone, an important food plant for this species, Purging Buckthorn (*Rhamnus cathartica*), is found in gallery woodland between Castlegar Bog and the nearby River Suck.

Discussion

The importance of regenerating cutaway for Irish butterflies has been described for certain sites such as Lullymore, Co. Kildare (Harding 2008). However, the baseline scenario for Castlegar still reflects habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators. Other species of Butterfly have been recorded on an *ad hoc* basis at Castlegar previously such as Meadow Brown, Small Copper, Ringlet and Silver-washed Fritillary and it is possible these may appear in future sampling survey results.

Table 2.11.3: 2022 – Monitoring YR1 Pollinator Survey Results

Species	**April**	**May**	**June**	**July**	**August**	**Total**
Brimstone *Gonepteryx rhamni*	1	0	0	0	2	3
Orange Tip *Anthocharis cardamines*	6	0	2	0	3	11
Peacock *Aglais io*	0	0	0	0	2	2
Small white *Pieris rapae*	4	0	1	1	2	8
Speckled wood *Pararge aegeria*	4	0	3	1	3	11
Total	15	0	6	2	12	35

2.11.3 Surface water quality

Castlegar bog has seven surface water outlets discharge to the River Suck IE_SH_26S071200. Three of these outlets are monitored as part of EDRRS (SW118, 123 & 124) and a composite sampler has been installed on the SW118. These outlets are shown on Drawing No. BNM-DR-22-01-32 in Appendix L0.

Analysis of the monitoring over 5 years under the IPC licence environmental monitoring programme when this bog was in active production, indicate that relevant parameters like Suspended Solids had an average of 4.5 mg/l, with Ammonia averaging 0.2815 mg/l as per results below.

Table 2.11.4: Castlegar Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS mg/l	TS mg/l	Ammonia mg/l	TP mg/l	COD mg/l	Colour
Castlegar	SW-119	Q4 19	6.2	<2	93	0.479	<0.05	57	291
Castlegar	SW-120	Q4 19	5	<2	106	0.079	<0.05	81	398
Castlegar	SW-121	Q4 19	4.2	<2	103	0.025	<0.05	88	453
Castlegar	SW-122	Q4 19	5.3	<5	239	0.027	<0.05	96	376
Castlegar	SW-123	Q4 19	6.9	3	109	0.18	<0.05	46	209
Castlegar	SW-124	Q4 19	6.5	5	115	0.202	<0.05	67	309
Castlegar	SW-117	Q2 18	7.9	5	302	0.55	0.09	54	174
Castlegar	SW-118	Q2 18	7.8	5	186	0.71	0.05	89	324
Average			6.225	4.5	156.625	0.2815	0.07	72.25	316.75

Monthly EDRRS baseline monitoring commenced in December 2020, which gave 20 sampling events for this report, up to July 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 3.6mg/l. Similarly, Ammonia had an average of 0.676 mg/l, which is more than when the bog was in active production but is trending in the right direction overall.

Castlegar rehabilitation commenced in Summer 2020 and since then overall trends remain neutral other than the higher than average Ammonia during the period, with some relationship between rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.2.

Surface water monitoring for the period and associate graphs are in Appendix L3.

2.11.4 Archaeology

Castlegar Bog was not included in the National Monuments Service archaeological monitoring programme and no archaeological finds were discovered and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, the 21 sightings identified in

Castlegar Bog by the Peatland Survey 2007 & 2008 were excluded from rehabilitation and protected with a 20m buffer. These sites are identified as toghers, platforms and archaeological wood.

2.11.5 Aerial Imagery / LiDAR

Castlegar Bog aerial images available prior to the commencement of the rehabilitation date from July 2017 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Castlegar Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.12 Cavemount Bog

Cavemount Bog is located in Co. Offaly, approximately 3km north east of the village of Daingean and 2km south west of the village of Rhode. The bog lies to the south side of the Grand Canal proposed National Heritage Area (pNHA). The area of the bog is 513 hectares. Cavemount Bog was drained and developed for industrial peat production in the 1970s while industrial peat production ceased completely in 2015. Further information on the bog is available in the Cavemount Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Cavemount Bog commenced in August 2021 and was on 90% complete at the end June 2022.

2.12.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Cavemount bog. A total of 15 locations comprised of 1 deep well and 15 Phreatic wells have been installed. 6 Phreatic wells have been instrumented with automated loggers, with a subset of the deep piezometers (1) instrumented with automated loggers. The locations of the wells are shown on Drawing No. BNM-DR-22-10-32 in Appendix M0. A total of four monitoring visits have been carried out to date at Cavemount bog as outlined in Appendix M1 - Cavemount Bog - Hydrological Monitoring, with manual dipping completed in July 2021, February 2022, and logger dipping in August 2022. Monitoring will be ongoing at Cavemount bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix M1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were deeper in Summer 2022 than Summer 2021 at most monitoring wells. However, at monitoring well CM_010s there has been a significant increase in water level following the implementation of rehabilitation measures (DCT2). Water levels were observed to increase over winter 2021/22 but did not drop significantly in Summer 2022 and remained close to the ground surface (within 10cm). In contrast, at other monitoring wells water levels increased over winter 2021/22 but dropped significantly during summer 2022, including CM_012s where WLT3 measures were implemented. This monitoring well was placed in a high field which is elevated above the surrounding area (by c. 0.8m). While further monitoring will be required, this suggests that despite water levels increasing in the surrounding area that water levels did not increase in the high field. Further investigations will be required to determine precise water level regime across the bog. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an

indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

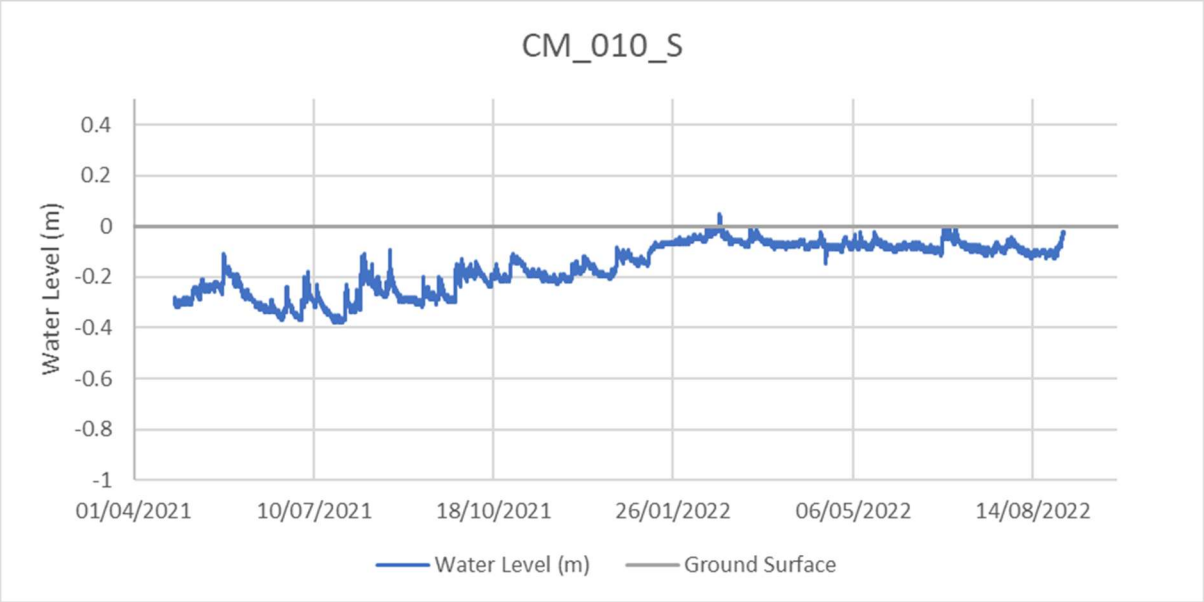

Figure 2.12.1: Hydrograph for monitoring well CM_010s

2.12.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Cavemount Bog during summer 2022.

Constraints

At the time of survey some areas of bare peat and pioneering revegetating within the western section of Cavemount had been rehabilitated to form bunded cells. Care was taken when surveying these areas due to some areas of open water and soft peat. However, this is not thought to have affected survey results, as there are still high fields present which were used.

Results

Cavemount bog is divided into two main sections, bisected by the Esker Stream, which flows south-east through the site. Much of the eastern side of the site is developing a mosaic of pioneer fen, wetland communities and scrub. This area was largely cutaway, is a shallow basin, has been re-wetting since 2012. Some targeted measures were carried out in this area to improve summer water levels across this section. Both sides are influenced by seasonal inundation when water levels are high in the River Esker.

Significant areas of open water support typical emergent pioneer vegetation communities. There is good cover of establishing reedbeds dominated primarily by the community '*Phragmites australis* community' (pPhrag) and to a lesser extent '*Typha* community' (pTyp). Pioneer fen occurs along the margins of the open water bodies in shallower water, often dominated by the species *Carex rostrata*

or *Eriophorum angustifolium* (pRos/pEang), see representative photo below. Some of the open waterbodies support extensive cover of *Equisetum fluviatile*. The high fields that occur in series through these wetlands are vegetating with the community ‘‘Emergent *Betula-dominated* community *(A)’* (eBir) and emerging *Juncus effusus* (‘Pioneer Juncus effusus community’ or pJeff) or *Eriophorum angustifolium* dominated poor fen habitats (‘Pioneer *Eriophorum angustifolium* community (poor fen)’ or pEang), see representative photo below.

The western part of the site has low-lying areas that are re-vegetating relatively quickly since peat extraction ceased in 2015. This is a mosaic of re-wetted bare peat, some shallow surface water and pioneer vegetation. This is beginning to colonise with some *Eriophorum angustifolium* (pEang), *Juncus effusus* (pJeff) and scattered birch scrub (eBir). There is more prominent bare peat towards the western margin. Where the bog is more elevated. This section also has pioneer vegetation, but to a lesser extent. More intensive rehabilitation measures were carried out in this area.

Within the western part of the site, extensive scrub and establishing woodland has developed in a drier part within the northern portion. This is dominated by *Betula pubescens* (eBir/cBir) with some *Salix cinerea*. Ground flora is dominated by *Eriophorum angustifolium* (pEang), *Juncus effusus* (pJeff) and some *Calluna vulgaris*, *Chamaenerion angustifolium*, *Holcus lanatus* and *Rubus fruticosus* agg.

It is too soon for habitats at Cavemount to reflect post rehabilitation change or vegetation succession. Some initial rewetting has been noted post the implementation of the EDRRS measures. The rehabilitation measures that have re-wetted the site will encourage the continued development of fen and wetland pioneer vegetation.

Some areas of the bog already have well established pioneer vegetation including fen, scrub and woodland. The habitats already present are expected to continue to develop and change with time. Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas.

Figure 2.12.2: Bare peat recolonising with Pioneer *Eriophorum angustifolium* .

Figure 2.12.3: Establishing scrub within the northeast of the bog.

Figure 2.12.4: Open water with establishing reedbeds.

Figure 2.12.5: Establishing woodland within the northwest of the bog.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Cavemount bog during summer of 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were identified.

Results

See Table 1 of Appendix M2. All quadrats were dominated by bare peat (91-100% cover). Many areas of Cavemount Bog, particularly those located above gravel ridges on shallow peat, have become vegetated with scattered *Betula pubescens*, *Juncus effusus*, *Eriophorum angustifolium* and *Triglochin palustris*. However, large parts of Cavemount bog are still dominated by bare peat. It is likely that these areas will, in time, develop similar vegetation while also being influenced by the EDRRS rehabilitation measures i.e. rewetting.

Discussion

As with habitats the quadrats reflect the current baseline conditions pre-rehabilitation. Post-rehabilitation, further time is required before any vegetation colonisation or change is likely to be recorded.

Figure 2.12.6: Quadrat Q1

Figure 2.12.7: Quadrat Q5

Winter Birds – Monitoring YR1

Method

Fixed counts, following I-WeBS methods, were used to count wintering waterfowl at Cavemount. A total of six counts were undertaken, covering the period September 2021 to February 2022 inclusive.

Constraints

Given the extent of suitable wetlands occurring at Cavemount bog, often difficult to survey due to the nature of the linear strips of established scrub on old high production fields, it is likely that some species have been under recorded, particularly Snipe, Little Grebe and Moorhen for example. In November, some EDRRS activity was still ongoing. Some limited disturbance was noted, with the occasional tractor commuting through one headland & one excavator working in the northwest corner. However, this is not considered to have affected the count.

Results – Species Richness

A total of 16 water bird species were recorded across all surveys. Five of these were BOCCI Red listed species (Gilbert *et al.* 2021) namely Golden Plover, Snipe, Redshank, Wigeon and Lapwing. Six Amber listed species were recorded, namely Mute Swan, Teal, Water Rail. Whooper Swan, Goosander and Little Egret.

Results – Abundance

Average abundance was highest for Lapwing (mean = 29) and a peak count of 119 recorded in November 2021 comprised of two separate flocks (85 and 34 individuals) occurring within the south and north of the site respectively. The species were recorded in flight on both occasions following being flushed from the bog by soaring buzzards. Average abundance was second highest for Mallard (n= 12) followed by Mute Swan (n=11). Golden Plover had the second highest peak count with 37 recorded in October of 2021. Whooper Swan was recorded in November, December and January indicating that the species uses the extensive wetlands during the core winter months, while likely also foraging in the wider landscape.

Results – Habitat Associations

Most of the wintering wildfowl records were associated with the extensive wetland scattered across the bog. Those located to the north of the site were regularly used by duck and swan species as they are longer established and thus likely support greater invertebrate and vegetative feeding opportunities. In addition, the larger wetlands provide greater protection from predators, with more open expanse of water. Snipe was found to associate more with vegetated drains at the bog or wetland margins. However, this is also likely to reflects the species propensity to flush from such habitats when approached during the survey. Two Redshank were recorded within a small wetland to the southeast of the bog in December 2022.

Discussion

The three Goosander (2 males & 1 female) recorded in wetlands within the north-northeast of Cavemount in February 2022 proved to be a significant record for Co. Offaly and the midlands generally. The only previous record of this species in Co. Offaly was of one male shot near Clonbullogue, Co. Offaly, January 18th 1963, as per the 2nd Mid Shannon Bird Report 1996-1999 (Heery, S. (ed.), 2000). The only other midlands record was a pair at Lough Owel, Co. Westmeath on 31st March 1947, reported in 3rd Mid Shannon Bird Report 2000-2003 (Heery, S. (ed.), 2004).

Mute Swan, Grey Heron, Snipe and Lapwing were all recorded on all but one date, indicating that this site supports the species throughout the winter months. Two Redshank were recorded within a small wetland to the southeast of the bog in December 2022. This species is likely to use the site intermittently during the winter months. A single Jack Snipe was recorded in December 2021. However, this species is likely to occur on site in greater abundance/frequency, as the species is usually only recorded after being flushed during walkover surveys in suitable vegetation. Similarly, Little Grebe, Moorhen, Wigeon and Ringed plover were all recorded infrequently.

Overall species richness (which is high) and abundance reflects the current baseline bog condition, with much of the south of the site still dominated by bare peat, which offers little or no foraging opportunities for many species of water bird. Over time, as supporting wetland habitats develop at Cavemount it is expected that it may also become a refugium for a diversity of wintering wildfowl species such as those recorded during the 2021-22 winter months. Post rehabilitation and associated revegetation, Cavemount may contribute to further habitat for a variety of wintering bird species of conservation concern occurring in the wider landscape. No significant change in wintering bird species richness and abundance can be attributed to the wetland rehabilitation so far at Cavemount, but measures have consolidated conditions for wetland habitats to continue to develop to support wintering bird species already using the site.

Table 2.12.1: Winter 2021/22 – Monitoring YR1 I-WeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Maximum
MS Mute Swan *Cygnus olor*	Amber	5	10	8	14	17	15	11	17
T. Teal *Anas crecca*	Amber	4	0	0	0	0	0	0	4
WA Water rail *Rallus aquaticus*	Amber	0	0	4	0	0	0	0	4
WS Whooper Swan *Cygnus cygnus*	Amber	0	0	4	6	12	0	7	12
GD Goosander *Mergus merganser*	Amber	0	0	0	0	0	3	0	3

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Maximum
LE Little grebe *Tachybaptus ruficollis*	Amber	0	0	0	0	0	2	0	2
H. Grey Heron *Ardea cinerea*	Green	3	1	3	2	1		2	3
RP Ringed Plover *Charadrius hiaticula*	Green	1	0	0	0	0	0	0	1
MA Mallard *Anas platyrhynchos*	Green	12	11	8	0	0	16	12	16
MH Moorhen *Gallinula chloropus*	Green	0	0	1	0	0	0	0	1
JS Jack Snipe *Lymnocryptes minimus*	Green	0	0	0	1	0	0	0	1
SN Snipe *Gallinago gallinago*	Red	1	2	2	0	3	5	3	5
GP Golden Plover *Pluvialis apricaria*	Red	0	37	0	0	0	0	7	37
L. Lapwing *Vanellus vanellus*	Red	3	15	119	1	0	9	29	119
WN Wigeon Anas penelope	Red	0	0	1	0	0	1	1	1
RK Redshank *Tringa totanus*	Red	0	0	0	2	0	0	0	2

Breeding Birds – Monitoring YR1

Methods

At Cavemount, three 500 metre transects were selected to provide a representative sample of the breeding bird community. Each transect was placed along an existing high field, headland or rail line corridor for ease of use but also because these locations will continue to be accessible post rehabilitation, allowing the same route to be repeated. Four visits in the period April 2022 to July 2022 were carried out. In addition, a breeding wader survey was carried out in line with O'Brien & Smith 1992, which comprised walking a predefined route or transect across the bog on each of 4 visits in the period April to July inclusive. The route aligned with the above CBS transects for ease of implementation. See the Figure in Appendix M2 titled '*Cavemount Bog Ecology Transects'* for transect location information.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, headlands or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to transect routes i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am -11:00am). CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. The timing of some visits may have exceeded the CBS recommended period for surveying but were complete by 11:00am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 47 no. species were recorded, see Table 2.12.2. This included six BoCCI (Gilbert *et al.* 2021) Red listed species, Black headed gull, Lapwing, Meadow Pipit, Kestrel, Swift and Snipe. Twelve BoCCI Amber listed species namely, Grasshopper Warbler, House Martin, Lesser Black-backed Gull, Little Grebe, Linnet, Mallard, Mute Swan, Skylark, Sand Martin, Teal, Water Rail and Willow Warbler. Remaining species (n=29) were all Green listed apart from Pheasant which is not assigned a BoCCI status.

A bespoke breeding waders survey was undertaken, data on wading species recorded is herein presented in line with an interpretation following the O'Brien and Smith 1992 method for censusing lowland breeding wader populations. Breeding waders recorded along the walked transects include; 8-9 pairs of Lapwing, 23 pairs of Snipe (recorded in all months and a maximum count of 23 drumming/chipping birds in June 2022), 2 pairs of Ringed Plover and 1 probable pair of Common Sandpiper bred onsite in 2022.

Results – Annual Relative Abundance

Annual Relative Abundance (ARA) is presented as the maximum count per species per visit (Early or Late) or as the maximum count for the period April to June inclusive, see Table 2.12.2. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 10 individuals were recorded for 16 species, Robin, Reed Bunting, Linnet, Snipe, Hooded Crow, Black-headed Gull, Lapwing, Skylark, Blackcap, Mallard, Pied Wagtail, Wren, Sand Martin, Blackbird, Meadow Pipit and Willow Warbler. All remaining species were recorded in low numbers (typically less than 5). Overall abundance was highest for Willow Warbler with a maximum of 63 individuals recorded in the period April to June.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran (2012). The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Thirty one species associated with OPEN habitats were recorded and sixteen species associated with NON-OPEN habitats were recorded see Table 2.12.2.

All breeding waders, with the exception of Snipe, were restricted to the large wetland within the north of the railway that bisects the site. It is likely that the numbers of Snipe in particular are underestimated for the entire bog and that the numbers recorded are restricted to the wider area adjacent to the walked transect.

Results – Colonial Species

No colonies were recorded.

Discussion

It is notable that the four Red listed species recorded, Black headed Gull, Lapwing, Meadow Pipit, Kestrel, Swift and Snipe are associated with open habitats targeted for rehabilitation in the form of rewetting, and would be expected to gain from many of the measures implemented (wetland creation and fertiliser application to high fields for example). The Red listed species, Meadow Pipit associates with drier open habitats and had the second highest relative abundance overall or highest overall for species associated with cutaway i.e. open habitats. Overall, the total number of species either Red or Amber listed was 18. Although Common Sandpiper were only recorded in May 2022, it is considered likely that the species did breed at the site, given the suitability of the habitat and that the species may have been overlooked on other visits due to the nature of the vegetation. Although Raven, including fledged juveniles were recorded using Cavemount bog for feeding, the species is known to breed on a high voltage pylon located on raised bog outside the northwest of the site boundary.

Breeding waders such as Snipe, Ringed Plover, Common Sandpiper and Lapwing may increase over time following peatland rehabilitation measures and the associated increase in area of suitable wetlands. Current breeding estimates for Snipe are considered high with 23 pairs at minimum breeding on site in 2022.

Regarding habitat associations, almost 60% of species recorded are more associated with open habitats. Open habitat species comprise 17 of the 18 Red and Amber listed species recorded, with only one Amber species associated with non-open habitats (Willow Warbler). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case. Further analysis on trends in the ratio or relative abundance of these species over time following rehabilitation would be beneficial.

In general, the abundance estimates reflect the expansive area of wetland and scrub habitats currently present at Cavemount, as well as the associated marginal habitats i.e. remnant bog, scrub and woodland. In time, the extensive areas of bare peat within the south of the site will provide more suitable habitat for many species. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds and establishes the potential importance of Cavemount for breeding waders in particular.

Table 2.12.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	27
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	18
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	15
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	3
BZ Buzzard *Buteo buteo*	Green	OPEN	1
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	5
CK Cuckoo *Cuculus canorus*	Green	OPEN	4
CS Common Sandpiper *Actitis hypoleucos*	Green	OPEN	2
D. Dunnock *Prunella modularis*	Green	NON-OPEN	2
ET Little Egret *Egretta garzetta*	Green	OPEN	1
GH Grasshopper Warbler *Locustella naevia*	Amber	OPEN	1
GR Greenfinch *Carduelis chloris*	Green	NON-OPEN	1

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
H. Grey Heron *Ardea cinerea*	Green	OPEN	6
HC Hooded Crow *Corvus cornix*	Green	OPEN	15
HM House Martin *Delichon urbicum*	Amber	OPEN	3
JD Jackdaw *Corvus monedula*	Green	NON-OPEN	2
K. Kestrel *Falco tinnunculus*	Red	OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	17
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	3
LG Little Grebe *Tachybaptus ruficollis*	Amber	OPEN	5
LI Linnet *Carduelis cannabina*	Amber	OPEN	12
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	9
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	2
MA Mallard *Anas platyrhynchos*	Amber	OPEN	21
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	46
MS Mute Swan *Cygnus olor*	Amber	OPEN	7
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	3
PW Pied Wagtail *Motacilla alba*	Green	OPEN	21
R. Robin Erithacus rubecula	Green	NON-OPEN	10
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	10
RN Raven *Corvus corax*	Green	OPEN	6
RO Rook *Corvus frugilegus*	Green	NON-OPEN	1
RP Ringed Plover *Charadrius hiaticula*	Green	OPEN	4
S. Skylark *Alauda arvensis*	Amber	OPEN	18
SC Stonechat *Saxicola rubicola*	Green	OPEN	4
SH Sparrowhawk *Accipiter nisus*	Green	NON-OPEN	4
SI Swift *Apus apus*	Red	OPEN	2
SM Sand Martin *Riparia riparia*	Amber	OPEN	26
SN Snipe *Gallinago gallinago*	Red	OPEN	13
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	5
T. Teal *Anas crecca*	Amber	OPEN	2
WA Water Rail *Rallus aquaticus*	Amber	OPEN	2
WH Whitethroat *Sylvia communis*	Green	OPEN	4
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	5
WR Wren *Troglodytes troglodytes*	Green	OPEN	22
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	63

Pollinators-YR1

Methods

Two pollinator surveys were carried out in monitoring Year 1 (2021). This survey effort is in line with the proposed survey scope for 2021, which specified that pollinator transects would be carried out if resources were available. The transect carried out in 2021 was approximately 3km in length. The transect commenced at the north of Cavemount and followed the railway line south-east, before veering west across a high field in the former production area. An additional 500m pollinator transect was carried out in the south-western corner of the bog. All surveys were completed between 10:50am

and 02:00pm, when the temperature was at least 13°C and during good weather conditions. See the Figure in Appendix M2 titled '*Cavemount Bog Ecology Transects'* for transect location information.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results – Species Richness

Species richness was relatively high in year 1. A total of twelve species of butterfly were recorded namely, Common Blue, Green-veined White, Meadow Brown, Ringlet, Small Copper, Small Tortoiseshell, Small White, Large White, Peacock, Wall Brown, Speckled Wood and Red Admiral.

In addition to butterflies the following invertebrates were also recorded during the surveys; Bombus sp. (n = 3), Buff-tailed Bumblebee (n = 2), White-tailed Bumblebee (n=5), Common Darter (n = 23), Common Hawker (n = 4), Common darter (n = 3), Emerald Damselfly (n = 4), Blue-tailed damselfly (n = 1), Common Blue Damselfly (n=2), Four-spotted Chaser (n = 4), Brown Hawker (n = 7), Latticed Heath (n= 2) and Common Heath (n= 5).

Results – Abundance

A total of 133 individuals were recorded during the surveys. Common Blue occurred in the highest abundance (46 overall), with the maximum abundance of this species recorded during the August survey. Small Tortoiseshell and Small White were also recorded in high abundance (21 and 20 respectively). The highest abundance of all species overall per month was recorded in August.

Results – Habitat Associations

The first section of the transect in year 1 (transect A) and the year 1 additional transect in the SW corner of Cavemount crosses pioneer open habitats, open water and bare peat. Butterfly diversity and abundance was low in this section of the transect, due to the poorly developed vegetation and lack of suitable foraging habitat for pollinators. The second section of the transect (transect B) follows the railway track and is vegetated with dry calcareous grassland with a high floristic diversity and abundant Common Knapweed. This section of the transect had the highest species abundance during the surveys in 2021.

Discussion

The baseline scenario for Cavemount established in 2021 still reflects habitats comprised largely of bare peat, pioneering vegetation and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators. The occurrence of Wall Brown is notable in the Co. Offaly context.

Table 2.12.3: 2021 – Monitoring YR1 Pollinator Survey Results

Species	July	July	August	Total
Common Blue *Polyommatus icarus*	0	4	42	46
Green-veined White *Pieris napi*	0	1	0	1
Cryptic wood white *Leptidea juvernica*	3	0	0	3

Species	July	July	August	Total
Meadow Brown *Maniola jurtina*	3	7	0	10
Ringlet *Aphantopus hyperantus*	5	7	0	12
Small Copper *Lycaena phlaeas*	0	0	2	2
Small Tortoiseshell *Aglais urticae*	1	0	21	22
Small White *Pieris rapae*	0	20	0	20
Large White *Pieris brassicae*	0	0	8	8
Peacock *Inachis io*	0	0	1	1
Wall brown *Lasiommata megera*	0	0	1	1
Speckled wood *Pararge aegeria*	0	1	5	6
Red admiral *Vanessa atalanta*	0	1	0	1
Total	12	41	80	**133**

Pollinators-YR2

Methods

The transect carried out in 2022 (monitoring Year 2) was 2km in length and overlapped approximately 750m of the 2021 transect along the railway line and then veered west across a high field in the former production area. All surveys were completed between 10:50am and 02:00pm, when the temperature was at least 13°C and during good weather conditions. See the Figure in Appendix M2 titled '*Cavemount Bog Ecology Transects'* for transect location information.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results – Species Richness

A total of seven species of butterfly were recorded namely, Common Blue, Green-veined White, Meadow Brown, Orange Tip, Ringlet, Small Copper, Small Tortoiseshell, and Small White.

In addition to butterflies the following invertebrates were also recorded during the surveys; Common darter (n =18), Four spotted Chaser (n = 36), Common Hawker (n = 2), Brown Hawker (n = 1), Blue Tailed Damselfly (n = 6), Large Red Damselfly (n = 1), Bombus sp. (n = 11), Black Tailed Skimmer (n = 2), Common Blue damselfly (n = 8), Buff Tailed bumblebee (n = 1), Common Heath moth (n = 3) and Six-spot Burnet moth (n = 10).

Results – Abundance

A total of 45 individuals were recorded during the surveys. Common Blue occurred in the highest abundance (20 overall), with the maximum abundance of this species recorded during the August survey. The highest abundance of all species overall per month was recorded in August. The lowest species abundance was recorded during the survey in April.

Results – Habitat Associations

Butterfly diversity and abundance was low in transect A, due to the poorly developed vegetation and lack of suitable foraging habitat for pollinators. The second section of the transect (transect B) follows the railway track and is vegetated with dry calcareous grassland with a high floristic diversity and

abundant Common Knapweed. This section of the transect had the highest species abundance during the surveys in 2022.

Discussion

The baseline scenario for Cavemount in YR2 of monitoring still reflects habitats comprised largely of bare peat, pioneering vegetation and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRR
S scheme on Pollinators. The higher species richness and higher abundance recorded in year 1 relative to year 2 is reflective of the difference in transect length, with year one transects being an additional 1km in length. Weather may have also been an influence.

It is possible species richness and abundance may increase in future surveys along the transect route when the bare peat and pioneer vegetation communities become more established and the rehabilitated area begins to revegetate. The effects of fertiliser application in particular to headlands and high fields may increase the rate of colonisation by some species.

Table 2.12.4: 2022 – Monitoring YR2 Pollinator Survey Results

Species	April	May	June	July	August	Total
Common Blue *Polyommatus icarus*	0	0	6	0	14	20
Green-veined White *Pieris napi*	0	0	0	0	2	2
Meadow Brown *Maniola jurtina*	0	0	0	9	0	9
Orange Tip *Anthocharis cardamines*	1	5	0	0	0	6
Ringlet *Aphantopus hyperantus*	0	0	0	2	0	2
Small Copper *Lycaena phlaeas*	0	2	0	0	0	2
Small Tortoiseshell *Aglais urticae*	0	0	1	0	2	3
Small White *Pieris rapae*	0	0	0	1	0	1
Total	1	7	7	12	18	**45**

2.12.3 Surface Water Quality

Cavemount has five treated surface water outlets to the Esker Stream IE_SE_14E010200 which in turn feeds the Figile river IE_SE_14F010300. Two of these outlets are being monitored as part of EDRRS (SW20 and SW21) and the location of these outlets are shown on Drawing No. BNM-DR-22-10-32 in Appendix M0.

An analysis of 3 years of the IPC licence environmental monitoring of some of the discharges from this bog, indicate that relevant parameters like suspended solids had an average of 4 mg/l with ammonia averaging 0.598 mg/l, as per results below.

Table 2.12.5: Cavemount Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	pH	SS	TS	Ammonia	TP	COD	Colour
Cavemount	SW-20	Q4 18	7.8	5	298	0.02	0.05	85	325
Cavemount	SW-22	Q4 18	7.4	5	252	0.08	0.05	73	270
Cavemount	SW-22A	Q4 18	7.6	5	272	0.16	0.05	75	89
Cavemount	SW-20	Q1 17	8.1	5	260	0.07	0.08	56	132
Cavemount	SW-20	Q1 2020	7.7	4	216	0.063	0.06	78	262
Cavemount	SW-22	Q1 2020	7	2	137	0.118	0.06	84	297
Cavemount	SW-22A	Q1 2020	7.2	2	150	0.087	0.06	84	285

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 25 sampling events for this report, up to September 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with 7.5mg/l (SW20) and 7.9mg/l (SW21). Similarly, Ammonia averaging 0.1723 mg/l (SW20) and 0.0826 mg/l (SW21), which is less than when the bog was in active production.

Cavemount rehabilitation commenced in August 2021 and since then overall trends in the key water quality parameters remained flat during the period with sight improvements in Ammonia and some obvious relationship between rainfall and concentration of run-off of Ammonia but not Suspended Solids at these locations. During this period with significant drain blocking and some cell formation, there was one noticeable peak in suspended solids in August 2021 linked to a high rainfall event.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.67.

Surface water monitoring for the period and associate graphs are in Appendix M3.

2.12.4 Archaeology

This bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, there was one archaeological sighting in Cavemount Bog OF010-476---- unworked wood. This was preserved *in situ* and avoided by the rehabilitation works with a 20m buffer zone.

2.12.5 Aerial Imagery / LiDAR

Cavemount Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Cavemount Bog was carried

out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.13 Clonad Bog

Clonad Bog is in Co. Offaly, approximately 2km south of Daingean and c.2.5km north of Geashill. The area of the bog is 446 hectares. Clonad Bog was drained and developed for industrial peat production in the 1970s while industrial peat production ceased completely in 2020. Further information on the bog is available in the Clonad Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Clonad Bog commenced in September 2021 and was 77% complete at the end of June 2022.

2.13.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Clonad bog. A total of 21 Phreatic wells were installed and 11 Phreatic wells have been instrumented with automated loggers. The location of these wells are shown on Drawing No. BNM-DR-22-19-32 in Appendix N0. A total of four monitoring visits have been carried out to date at Clonad bog as outlined in Appendix N1 - Clonad Bog - Hydrological Monitoring, with manual dipping completed in August 2021, February 2022, and logger dipping in August 2022. Monitoring will be ongoing at Clonad bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works at Clonad Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed. It is envisaged that completion of these measures will have an impact on ground water levels generally within Clonad bog.

A summary of manual readings is provided in Appendix N1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were higher in Summer 2022 than Summer 2021. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the different in weather conditions leading up to the monitoring taking place. A review of logger data for a small number of wells indicates that water levels have increased significantly in some areas following the implementation of rehabilitation measures. In the case of monitoring well CD_003s, there has been a significant increase in the water table height (DPT4 measures). This increase occurs rapidly after the implementation of measures in October 2021, with water levels increasing towards the ground surface, before dropping to a maximum of 0.5m below ground surface during Summer 2022. However, this contrasts with maximum water levels of 0.9m below ground level during Summer 2021. It is important to note that this cell is located towards the top of a catchment and therefore is not expected to be receiving significant flows, highlighting the success of DPT4 measure in significantly increasing the water table height (albeit too low for peat formation to occur). More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

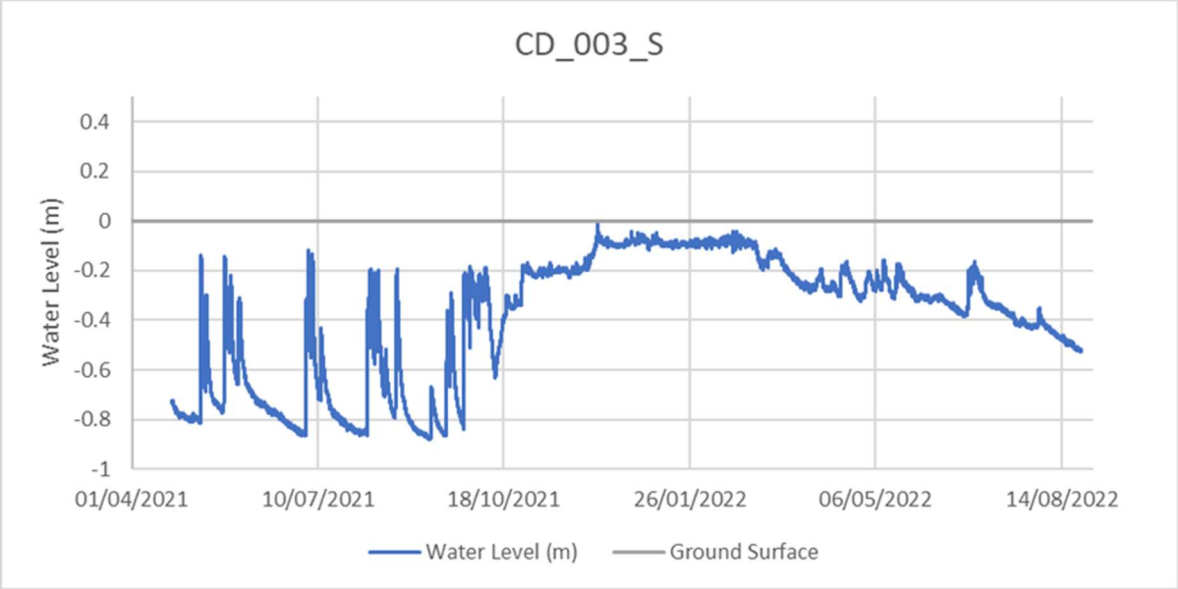

Figure 2.13.1: Hydrograph for monitoring well CD_003s

2.13.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Clonad Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

There are two main lobes to Clonad bog that are separated by a narrow connection. The majority of the western lobe of Clonad Bog is dominated by re-wetting bare peat. Scrub is developing in elevated section of the north-western section. The eastern lobe has more advanced vegetation development and is largely cutaway with pockets of pioneer habitat.

In wetter areas of bare peat, mosaics of the following communities are developing; 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang), 'Pioneer *Triglochin palustris* community' (pTrig), '*Carex rostrata* community' (pRos), and 'Pioneer *Juncus effusus* community' (pJeff), with vegetation reflecting the community 'Emergent *Betula*-dominated community (A)' (eBir) in drier areas. Mosaics of these communities are becoming established in the eastern and western part of Clonad.

Pioneering grassland equivalent to '*Anthoxanthum-Holcus-Equisetum* community' (gAn-H-Eq) and ruderal vegetation comprising '*Tussilago*-dominated community' (DisCF), are developing in areas of exposed glacial till along with emergent Birch. These community mosaics are prevalent in the north-western part of the site as glacial ridges and mounds underlie the peat and the subsoil is exposed.

Pockets of closed *Betula* scrub community (cBir) and *Betula-Salix* woodland (BirWD) have also developed, fringed with mosaics of emergent *Betula*-dominated community & pioneer *Juncus effusus*-community (eBir/pJeff). Birch woodland is particularly well developed in the central part of Clonad. The community '*Dactylis-Arrhenatherum* grassland' (gDact-Arr) and the dry grassland community 'Dry calcareous community' (gCal) occur along the railway line, fringing travel passes and along the tracks leading to the cutover bog in the north eastern part of the site.

Remnant raised bog (PB1) occurs in the north-east part of the site. This section is being actively cut for sod-turf and has been degraded, although it still retains some features of interest. The high bog contains typical raised bog characteristics (that qualifies as the Annex I EU Habitats Directive habitat – 'degraded raised bogs still capable of regeneration' 7120), although it is a poor example, and has been degraded by recent burning. Hydrological models indicate that 2.4 ha of high bog is potentially capable of reverting to active raised bog (Mackin et al. 2017b, NPWS 2017). However, only some minor drain-blocking was carried out in this bog remnant.

There is a mosaic of residual peat depths across Clonad and therefore variable water chemistry influences from underlying sub-soils. The majority of Clonad is formed on large topographical basins, on shallow residual fen peat. The underlying glacial till and lacustrine sub soils will have a greater alkaline influence on the water chemistry in these areas and influence the development of more alkaline habitats. However, at present no significant indicator species of alkaline ground-water influence were recorded during the habitat surveys. Areas of deep residual bare peat vary between 2.8 m - 4.5 m (in the SW of the former production area) and currently have no significant ecological indicators of more acidic water chemistry present (*Sphagnum* or frequent Heather).

Discussion

Rehabilitation was carried out at Clonad bog in 2021. It is too soon for habitats at Clonad to reflect post rehabilitation change or habitat succession. Almost no fresh pioneering vegetation is present in the areas of re-wetted bare peat that have undergone rehabilitation. Some areas of the bog already have well established pioneer vegetation including poor fen, and woodland and scrub habitats on drier ground. The habitats will continue to develop post rehabilitation.

Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas.

In conclusion the habitats recorded in 2021/2022 largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of pioneer vegetation cover at this site in the future.

Figure 2.13.2: Bare peat in the former production area.

Figure 2.13.3: Dry heather dominated vegetation

Figure 2.13.4: Pioneer *Juncus effusus* community.

Figure 2.13.5: Pioneer *Carex rostrata* community.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Clonad bog in June 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

No constraints were identified.

Results

See Table 1 of Appendix N2 for detailed quadrat data. Quadrats Q1, Q3, Q4 & Q5 were dominated by bare peat (91-100% cover). This area of Clonad is dominated by bare peat, with some scattered pockets of colonising bare pare peat comprising mainly of *Juncus effusus*, *Eriophorum angustifolium*, *Triglochin palustris and Betula pubescens* dominated scrub.

Quadrat Q2 was taken within an area of high bog (PB1) located to the north of the site. This quadrat location was chosen as it is located adjacent to a piezometer and is also representative of part of the degraded raised bog vegetation. As shown in the quadrat data, the area contained moderate Sphagnum cover (34-50%). *Sphagnum capillifolium*/subsp. *rubellum* was the dominant species, with *S. papillosum* and *S. cuspidatum* also occurring.

Discussion

As with habitats the quadrats reflect the current baseline conditions pre-rehabilitation. Post-rehabilitation, further time is required before any vegetation colonisation or change is likely to be recorded.

Figure 2.13.6: Quadrat Q1

Figure 2.13.7: Quadrat Q2

Winter Birds – Monitoring YR1

No winter bird counts were scoped in as part of Monitoring and Verification at Clonad Bog.

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 2 no. transect which was visited two times in the period April to June 2022. Both counts were conducted in calm conditions with zero wind and good visibility and spanned the period 08:11 to 09:50. The transect routes are shown in Appendix N2 on the figure titled '*Clonad Bog Ecology Transects'*.

Constraints

Due to their location sampling results may occasionally include species which utilise the areas adjacent to transects but which are not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am-11:00am). CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. CBS visits were generally complete by 10:00am so data is considered acceptable.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 29 no. species were recorded, see Table 2.13.1. This included three BOCCI (Gilbert *et al.* 2021) Red listed species Meadow pipit, Snipe and Black-headed Gull, along with 6 no. BOCCI Amber listed species namely Goldcrest, Mallard, Swallow, Skylark, Whooper Swan and Willow Warbler. Remaining species (n=21) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species across visit #1 or #2 or within the period April to June inclusive, see Table 2.13.1. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 20 individuals were recorded for three breeding species, Wren (n=29), Black-headed Gull (n=28) and Blackbird (n=22). Maximum counts of 10 or more individuals were recorded for Robin, Willow Warbler, Chaffinch, Meadow pipit, Chiffchaff and Blackcap (range 10-17). Numbers of other species were all <10 (range 1-7).

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Fourteen species considered associated with NON-OPEN habitats were recorded and fourteen species associated with OPEN habitats were recorded see Table 2.13.1. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

A colony of 10 pairs of Black-headed Gull was recorded.

Discussion

The occurrence on raised or cutaway bog of many of the species recorded in this study have been previously described in literature such as Wilson 1990, Bracken *et al.* 2008 and in unpublished reports such as Copland 2009,2010. Open habitat species comprise a higher proportion of Red and Amber listed species (7 no. in total of the 9 Amber or Red listed species). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009) on cutaway, and like many other scheme sites, appears to be borne out at Clonad also.

By far the most notable occurrence is the evidence of colonisation by Black-headed Gull post re-wetting. This Red listed species did not breed at Clonad prior to re-wetting and has effectively immediately colonised suitable habitat when made available. Black-headed Gull typically nest near shallow calm water in proximity to foraging habitats including open water itself but also nearby grasslands or ploughed land (Cramp *et al.* 1985). Black-headed Gull nest at many Bord na Móna bogs where suitable habitat is available, but this is often episodic in nature. An estimated 10 pairs bred at Clonad in 2022 in a bunded wetland. A maximum of 28 individuals was observed, but not all birds at a colony breed in any given year. It is hoped that rehabilitation may provide more permanent colony locations or refugia for this species across the EDRRS scheme.

The data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway bogs post rehabilitation and particularly highlights the potential for colonisation by a single Red listed species, Black-headed Gull.

Table 2.13.1: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	22
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	10
BZ Buzzard Buteo buteo	Green	OPEN	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	28
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	2
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	11
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	14
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
GC Goldcrest *Regulus regulus*	Amber	NON-OPEN	1
GO Goldfinch *Carduelis carduelis*	Green	OPEN	1
H. Grey Heron *Ardea cinerea*	Green	OPEN	1
HC Hooded Crow *Corvus cornix*	Green	OPEN	7
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	3
WH Whitethroat *Sylvia communis*	Green	NON-OPEN	7
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	1
MA Mallard *Anas platyrhynchos*	Amber	OPEN	3
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	14
P. Peregrine *Falco peregrinus*	Green	OPEN	1
R. Robin *Erithacus rubecula*	Green	NON-OPEN	17
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	2
SL Swallow *Hirundo rustica*	Amber	OPEN	3
S. Skylark *Alauda arvensis*	Amber	OPEN	6
SC Stonechat *Saxicola rubicola*	Green	OPEN	1
SN Snipe *Gallinago gallinago*	Red	OPEN	1
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	5
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	4
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	29
WS Whooper Swan *Cygnus cygnus*	Amber	OPEN	1
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	17

Pollinators-YR1

Methods

Two pollinator surveys were carried out in Year 1 (2021). This survey effort is in line with the proposed survey scope for 2021, which specified that a pollinator transect would be carried out if resources were available. All surveys were completed between 11:00am and 04:00pm, when the temperature

was at least 13°C and during good weather conditions. The transect routes are shown in Appendix N2 on the figure titled '*Clonad Bog Ecology Transects'*.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results – Species Richness

A total of three species of butterfly were recorded namely, Speckled Wood, Small White, Small Heath, Common Blue Small Tortoise Shell, Red Admiral, Large White, Painted Lady, Wall Brown, Meadow Brown and Small Copper.

In addition to butterflies, the following invertebrates were also recorded during the surveys: *Bombus* sp. (n = 13), Buff-tailed Bumblebee (n = 2), Red-tailed Bumblebee (n = 1), Common Darter (n = 2), Ruddy Darter (n = 1), Common Hawker (n = 1), Blue tailed Damselfly (n = 3), Azure Damselfly (n = 1), Four Spot Chaser (n = 5), Hoary Bell (n = 1) and Cinnabar Moth (n = 1).

Results – Abundance

Small tortoise shell occurred in the highest abundance (7 overall), with maximum abundance of this species recorded during the August survey. The highest abundance overall per month was recorded in August (16 individuals), with double number of individuals recorded in June.

Results – Habitat Associations

The transect followed in 2021 primarily encountered pioneering open habitats and bare peat, with species rich dry grassy verges along the northern section of the transect.

Discussion

The baseline scenario for Clonad established in 2021 reflected baseline habitats (i.e. pre-rehabilitation) and comprised largely of bare peat, pioneering vegetation and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators. The 2021 transect follows a route which passes through areas which have more well-developed pioneer vegetation compared to the route followed in 2022 and is double the length of the transect followed in 2022. This can account for the higher species abundance and higher species diversity recorded in 2021.

Table 2.13.2: 2021 – Monitoring YR1 Pollinator Survey Results

Species	**June**	**August**	**Total**
Speckled Wood *Pararge aegeria*	2	1	3
Small White *Pieris rapae*	2	0	2
Small Heath *Coenonympha pamphilus*	3	0	3
Common Blue *Polyommatus icarus*	1	0	1
Small Tortoiseshell *Aglais urticae*	0	7	7
Red Admiral *Vanessa atalanta*	0	1	1
Large White *Pieris brassicae*	0	2	2
Painted Lady *Vanessa cardui*	0	1	1

Species	June	August	Total
Wall Brown *Lasiommata megera*	0	1	1
Meadow Brown *Maniola jurtina*	0	2	2
Small Copper *Lycaena phlaeas*	0	1	1
Total	8	16	**24**

Pollinators-YR2

Methods

The 2021 survey transect was 2km and followed a loop in the eastern lobe of the bog. The transect carried out in 2022 (YR2) is 1km in length and follows a different route, located in the north-western part of the bog. The route was changed in 2022, as the original route lies in an area that has undergone rehabilitation and will develop as wetland in future, and therefore will be likely become inaccessible during future surveys. The 2022 transect route is shown in the Figure titled '*Clonad Bog Ecology Transects'* of Appendix N2.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results – Species Richness

Overall species richness was low. A total of three species of butterfly were recorded namely, Meadow Brown, Small Copper and Small White. In addition to butterflies, White Tailed Bumblebee (n = 2), White Tailed Bumblebee (n = 1), and Four Spotted Chaser (n=2) were also recorded during the surveys.

Results – Abundance

Meadow Brown and Small White occurred in the highest abundance (3 overall), with maximum abundances recorded during the July survey and the August survey respectively. The highest abundance overall per month was recorded in August. No butterfly species were recorded during the first two surveys in April and June.

Results – Habitat Associations

The 2022 transect was located in the north-west of the bog. The majority of the transect crosses bare peat, with some pioneering vegetation in the wider area of the transect. In general, little or no pollinator activity was clearly associated with bare peat or recently rehabilitated bare peat areas. Species recorded on bare peat sections of the transect were primarily traversing the transect to nearby vegetated drains, as insufficient vegetation is present on the transect to attract feeding pollinators. A higher proportion of pollinators were encountered at the beginning of the transect (the northern extent) which passes through the vegetated headland.

Discussion

The scenario for Clonad in 2022 still reflects habitats comprised largely of bare peat (post rehabilitation), with developing pioneer vegetation. On this basis ongoing monitoring in the medium and longer term is required to determine the full effects over time, post rehabilitation under the EDRRS scheme on Pollinators.

Other species of Butterfly were noted outside the transect during the surveys, with particularly high numbers of species occurring along the railway running along the northern boundary including Green Veined White, Orange Tip, Common Blue, Small Copper, and Small White. The railway is well vegetated and is fringed by grassy verges and scrub. It is possible these species may appear in future sampling survey results along the transect route when the rehabilitated area begins to revegetate. The effects of fertiliser application in particular to headlands and high fields may increase the rate of colonisation by some species.

Table 2.13.3: 2022 – Monitoring YR2 Pollinator Survey Results

Species	April	June	July	July	August	Total
Meadow Brown *Maniola jurtina*	0	0	1	2	0	3
Small Copper *Lycaena phlaeas*	0	0	0	0	1	1
Small White *Pieris rapae*	0	0	0	0	3	3
Total	0	0	1	2	4	**7**

2.13.3 Surface Water Quality

Clonad has three treated surface water outlets, two to the Daingean IE_SE_14D060200 and one south to the Tullamore River IE_SH_25T030100. One of these outlets is monitored as part of EDRRS (SW12A) and this location is shown on Drawing No. BNM-DR-22-19-32 in Appendix N0.

An analysis of 5 years of the IPC licence environmental monitoring programme, indicate that relevant parameters like suspended solids had an average 6.7 mg/l with Ammonia averaging 0.69 mg/l, as per results below.

Table 2.13.4: Clonad Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sample Date	pH	SS	TS	Ammonia	TP	COD	Colour
Clonad	SW-12	Q3 19	29/07/2019	7.8	5	382	0.88	0.07	51	87
Clonad	SW-12A	Q3 19	29/07/2019	8.1	5	322	0.05	0.05	41	83
Clonad	SW-13	Q3 19	29/07/2019	7.7	5	274	0.6	0.07	49	114
Clonad	SW-12	Q1 18	21/03/2018	7.4	5	230	0.54	0.08	69	163
Clonad	SW-12A	Q1 18	21/03/2018	7.8	5	330	0.85	0.05	37	66
Clonad	SW-13	Q1 18	21/03/2018	7.3	5	174	1	0.05	40	88
Clonad	SW-13	Q2 16	12/05/2016	7.9	5	248	1.3	0.05	43	114
Clonad	SW-12A	Q2 16	12/05/2016	7.9	20	324	0.7	0.05	44	66
Clonad	SW-12	Q4 16	13/10/2016	8	6	348	0.29	0.05	57	37

Monthly EDRRS baseline monitoring commenced in November 2020, which gave 20 sampling events for this report, up to September 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 3mg/l. Similarly, Ammonia had an average of 0.306 mg/l, which is less than when the bog was in active production. Clonad rehabilitation commenced in June 2021 and since then overall trends remained largely neutral with a slight rise in Suspended Solids and corresponding reduction in Ammonia.

During the period there was a clear but lagging relationship between rainfall and concentration of run-off at this emission point, but no significant spikes in Suspended Solids when significant drain blocking and cell formation were underway.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.82.

Surface water monitoring for the period and associate graphs are in Appendix N3

2.13.4 Carbon

Carbon monitoring is being carried out on Clonad bog. Four chamber measurement sites are located on Clonad and are described in Section 3 of this report (Table 3.1). Monitoring data is not yet available for this chamber monitoring.

2.13.5 Archaeology

This bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, four extant or possibly extant sightings identified were avoided - OF018-200----CND001aKnockballyboy, OF018-200----CND001b Knockballyboy, OF018-016----Cnd004a Rathfeston, and OF018-202----Cnd005 Rathfeston, with a 20m buffer.

2.13.6 Aerial Imagery / LiDAR

Clonad Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Clonad Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.14 Esker Bog

Esker Bog is in Co. Offaly, approximately 3.5km southeast of Rhode. The area of the bog is 566 hectares. The Bog was drained and developed for industrial peat production in the early 1970s while industrial peat production ceased completely in 2019. Further information on the bog is available in the Esker Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Esker Bog commenced in May 2021 and was 945 complete at the end of June 2022.

2.14.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Esker bog. A total 9 deep wells and 25 Phreatic wells have been installed in 25 locations and 10 Phreatic wells have been instrumented with automated loggers, with a subset of the deep piezometers (1) instrumented with automated loggers. The locations of the wells are shown on Drawing No. BNM-DR-22-17-32 in Appendix O-0. A total of four monitoring visits have been carried out to date at Esker bog as outlined in Appendix O1 - Esker Bog - Hydrological Monitoring, with manual dipping completed in July 2021, February 2022, and logger dipping in August 2022. Monitoring will be ongoing at Esker bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works at Esker Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed. It is envisaged that completion of these measures will have an impact on ground water levels generally within Esker Bog.

A summary of manual readings is provided in Appendix O1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were typically higher across most monitoring wells in Summer 2022 than Summer 2021, although there are a number of exceptions. This is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the different in weather conditions leading up to the monitoring taking place.

A review of logger data for a small number of wells indicates that water levels have increased significantly in some areas following the implementation of rehabilitation measures. In the case of monitoring well ES_011s, there has been a significant increase in the water table height. This increase occurs rapidly after the implementation of measures (DPT3) in late autumn 2021, with water levels increasing to approximately 0.25m above ground level during winter months. During the summer months water levels remain within 0.25m of the ground surface at this monitoring point. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

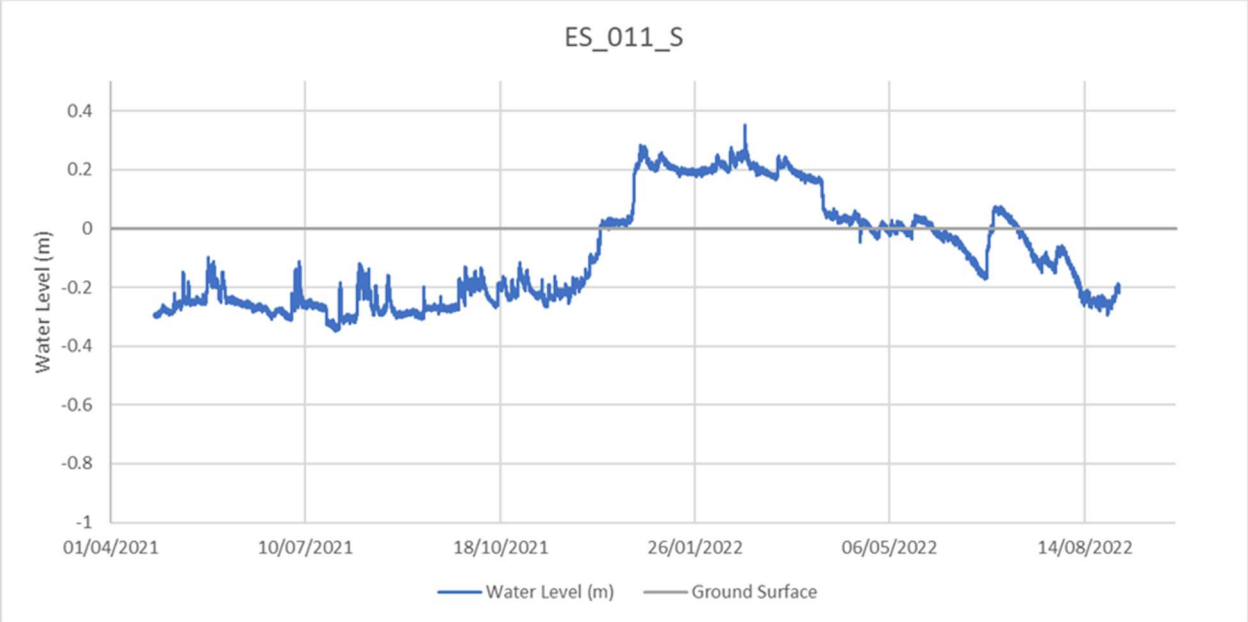

Figure 2.14.1: Hydrograph for monitoring well ES_011s

2.14.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Esker Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

There are two main lobes to Esker bog (eastern and western) divided by the Doden river. The majority of Esker Bog is still bare peat (approximately 90%). The western lobe is predominantly re-wetted bare peat, with some small areas of emerging pioneer vegetation and paths of shallow surface water. The pioneer vegetation includes mosaics of the following communities pioneer *Eriophorum angustifolium* community (pEang), pioneer *Juncus effusus* community (pJeff) and emergent *Betula*-dominated community (eBir), developing at the ends of some fields and in the drains. This lobe this is bisected by a Bord na Móna railway line. The Esker Stream flows along the southern boundary of the western lobe of the bog. This stream is typical of a lowland depositing river and is infilled with emergent riparian vegetation.

The zone between the two sections of bog is occupied by silt ponds and associated habitats such as disturbed vegetation (ED3), scrub and rank grassland (GS2) on the soil heaps and dry calcareous grassland (gCal/GS1) developing along the travel paths.

The smaller eastern area is largely cutaway with developing pioneer cutaway vegetation. This lobe of the bog has more well-developed habitats including emerging pioneer poor fen and more established Birch scrub and woodland. On the higher and drier areas in the north-west of Esker, well developed

Betula-Salix woodland (BirWD/WN7) is developing. Round leaved wintergreen *Pyrola rotundifolia* was recorded frequently in the ground flora of this woodland.

A mosaic of rush-dominated poor fen communities, scrub and bare peat occur over much of the remainder of the eastern lobe, forming mosaics of the following communities; 'Bare peat (0-50% cover)' (BP), 'Open *Betula*-dominated community (B)' (oBir), 'Closed *Betula* scrub community (C)' (cBir), 'Emergent Betula-dominated community (A)' (eBir), 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang), 'Pioneer *Juncus effusus* community' (pJeff) and 'Pioneer *Triglochin palustris* community' (pTrig). Esker Bog has a mosaic of different overlapping environmental characteristics influenced by residual peat depths, sub-soils, hydrology and drainage regime. Areas of deep residual peat in the western lobe of the bog have not yet developed significant ecological indicator species relating to acidic water chemistry at present, and these areas remain dominated by bare peat (black fen peat/red acidic peat). Ecological indicators of shallow residual peat and sub-soil influence on water chemistry are developing in the eastern lobe of the bog, characterised by poor fen species (*Eriophorum* sp. and *Juncus* sp.) typical of nutrient poor water chemistry.

Rehabilitation was carried out at Esker bog in 2021. It is too soon for habitats at Esker to reflect post rehabilitation change or succession. Very little new pioneering vegetation is present in the areas of bare peat that have undergone rehabilitation. Some areas of the bog already have well established pioneer vegetation including poor fen, Birch woodland and scrub habitats in the eastern lobe of the bog. The habitats already present are expected to continue to develop post rehabilitation.

Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas.

In conclusion the habitats recorded in 2021/2022 largely reflect the baseline status of a recently transformed peat extraction site.

Figure 2.14.2: Bare peat and pioneer open habitats and scrub in the eastern lobe of Esker.

Figure 2.14.3: Dry heather dominated vegetetaion and scrub in the northern section of the eastern lobe.

Figure 2.14.4: Pioneer *Juncus effusus* (pJeff) community, with emergent Birch scrub developing in the former production fields in the western lobe of Esker.

Figure 2.14.5: Bare peat, standing water and developing *Juncus effusus* (pJeff) community in the eastern lobe.

Vegetation Quadrats

No vegetation quadrats were scoped in as part of habitat Monitoring and Verification at Esker Bog.

Winter Birds

No winter bird counts were scoped in as part of Monitoring and Verification at Esker Bog.

Breeding Birds

No breeding bird counts were scoped in as part of Monitoring and Verification at Esker Bog.

Pollinators

No Pollinator counts were scoped in as part of Monitoring and Verification at Esker Bog.

2.14.3 Surface Water Quality

Esker Bog has seven surface treated water outlets to the Esker Stream IE_SE_14E010200 and eventually the Figile River IE_SE_14F010300. Three of these outlets are monitored as part of EDRRS (SW 24, 26 & 27) and these locations are shown on Drawing No. BNM-DR-22-17-32 in Appendix O-0.

An analysis 5 years of the IPC licence environmental monitoring programme, indicate that relevant parameters like Suspended solids had an average of 9.38 mg/l with Ammonia averaging 1.52 mg/l.

Table 2.14.1: Esker Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sample Date	pH	SS	TS	Ammonia	TP	COD	Colour
Esker	SW-24	Q2 2020	09/06/2020	8.3	3	257	0.013	0.05	45	113
Esker	SW-25	Q2 2020	09/06/2020	8	21	412	0.026	0.31	88	202
Esker	SW-26	Q2 2020	09/06/2020	8.4	9	364	0.141	0.05	16	82.7
Esker	SW-27	Q2 2020	09/06/2020	8.6	10	212	1.44	0.05	41	177
Esker	SW-28	Q2 2020	09/06/2020	7.9	3	410	0.032	0.05	41	107
Esker	SW-29	Q2 2020	09/06/2020	8.5	5	569	0.06	0.05	66	109
Esker	SW29-A	Q2 2020	09/06/2020	7.9	9	651	0.396	0.05	60	124
Esker	SW-24	Q3 18	12/09/2018	7.6	52	276	0.02	0.05	49	86
Esker	SW-25	Q3 18	12/09/2018	7.1	5	222	0.83	0.11	87	164
Esker	SW-26	Q3 18	12/09/2018	7.3	5	166	4.6	0.06	86	351
Esker	SW-27	Q3 18	12/09/2018	7.5	6	296	0.53	0.06	37	76
Esker	SW-28	Q3 18	12/09/2018	7.6	5	316	0.1	0.05	39	100
Esker	SW-29	Q3 18	12/09/2018	6.2	5	231	5.6	0.05	159	446
Esker	SW29-A	Q3 18	12/09/2018	7.6	5	242	5	0.1	116	355
Esker	SW-24	Q1 17	02/03/2017	7.4	6	130	0.47	0.05	79	242
Esker	SW-25	Q1 17	02/03/2017	6.6	8	84	0.49	0.05	81	244
Esker	SW-26	Q2 17	28/06/2017	7.2	5	172	4.3	0.05	112	325
Esker	SW-27	Q2 17	28/06/2017	7.6	5	298	0.9	0.05	59	131
Esker	SW-28	Q2 17	28/06/2017	7.5	5	306	1.6	0.05	81	160
Esker	SW-29	Q2 17	28/06/2017	7.2	15	230	2.3	0.05	126	338
Esker	SW29-A	Q2 17	28/06/2017	7.1	10	135	3.1	0.05	113	367

Monthly EDRRS baseline monitoring commenced in November 2020, which gave 23 sampling events for this report, up to September 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, SW 24 – 4.3 mg/,l SW 26 – 8.5 mg/l and SW 27 – 7 mg/l Similarly, Ammonia had SW 24 - 0.162043 mg/l, SW 26 - 1.106435 mg/l and SW 27 - 0.56813 mg/l with and overall average of 0.612 mg/l, which is less than when the bog was in active production. Esker rehabilitation commenced in May 2021 and since then overall trends remained relatively stable in Suspended Solids flat during the period with an obvious relationship between rainfall and concentration of run-off at SW26 and 27, less so at SW24.

In relation to Ammonia, there were mixed trends across the three outlets, with SW24 remaining relatively stable. During this period with significant drain blocking and cell formation, there were some noticeable peaks in Suspended Solids at SW26 in April 2022.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.8.

Surface water monitoring for the period and associate graphs are in appendix P3.

2.14.4 Archaeology

Esker Bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were found and reported during the rehabilitation measures. During the Archaeological Impact Assessment desk study, there was no known archaeology monuments identified in the rehabilitation area requiring protection.

2.14.5 Aerial Imagery / LiDAR

Oughter Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Esker Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.15 Mountlucas Bog

Mountlucas Bog is located approximately eight kilometres south-east of Daingean in Co Offaly. The area of the bog is 1,229 hectares. Bord na Móna has constructed a 28 turbine (80 MW) wind farm at Mountlucas and this is operational since 2014. Peat Production at Mountlucas commenced in the mid-1970's and ceased in 2020. Further information on the bog is available in the Mountlucas Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Mountlucas Bog commenced in June 2021 and was 95% complete at the end of June 2022.

2.15.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Mountlucas bog. A total of 29 nests comprised of 1 deep well and 29 Phreatic wells have been installed, 16 Phreatic wells have been instrumented with automated loggers, with a subset of the deep piezometers (1) instrumented with automated loggers. The location of these wells are shown on Drawing No. BNM-DR-22-11-32 in Appendix P0. A total of four monitoring visits have been carried out to date at Mountlucas bog as outlined in Appendix P1 - Mountlucas Bog - Hydrological Monitoring, with manual dipping completed in August 2021, February 2022, and logger dipping in September 2022. Monitoring will be ongoing at Mountlucas bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works at Mountlucas Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed. It is envisaged that completion of these measures will have an impact on ground water levels generally within Mountlucas Bog.

A summary of manual readings is provided in Appendix P1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were considerably higher across all wells dipped in summer 2022 compared to summer 2021. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place.

The logger data from well ML_008_S shows the water levels were extremely deep during summer 2021 (reaching 1.2m below ground level), before gradually rising throughout autumn and winter

2021/22 before steadily declining again in Summer 2022. However, the water level at this monitoring well, does not decline as deep and reaches a maximum of 73cm below ground surface during summer 2022. This is located in an area where DPT3 measures were utilised. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

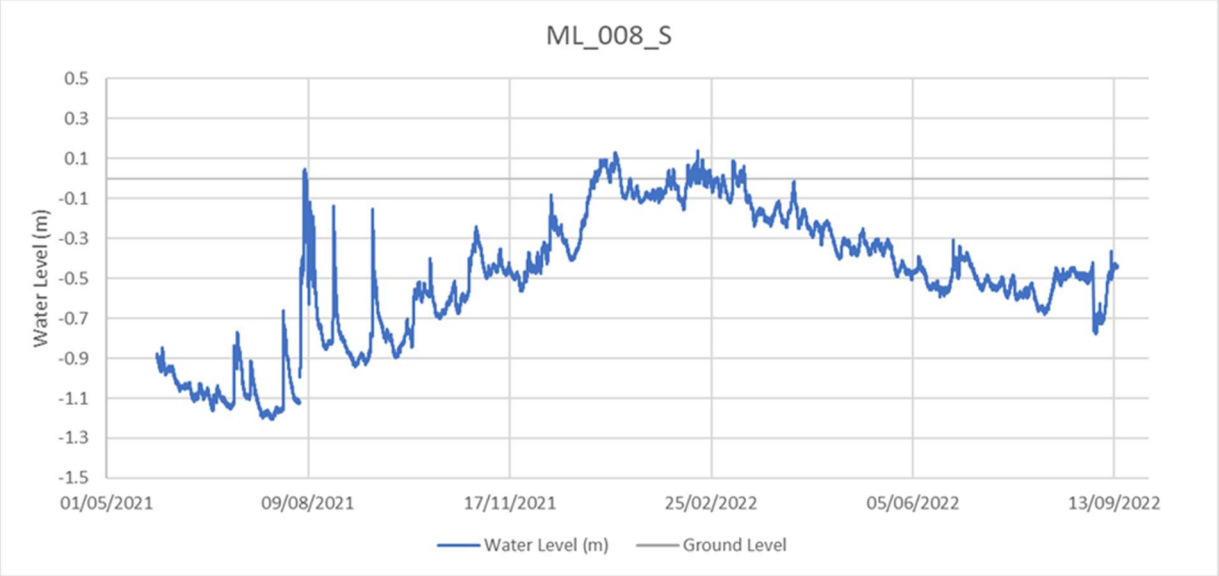

Figure 2.15.1: Hydrograph for monitoring well ML_008s

2.15.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Mountlucas Bog during summer 2021 and 2022.

Constraints

At the time of survey some areas of bare peat across the EDRRS area of Mountlucas had been rehabilitated to form bunded cells. Many of these areas are not safe for access due to standing water or soft conditions and have be avoided. However, this is not thought to have affected survey results however as there are still high fields present which can be used for access and these areas are at present entirely bare peat with little to no vegetation present.

Results

Mountlucas bog can be split into two sections for the purpose of reporting on rehabilitation;
1) The majority of the site, which has been cutaway for some time and is dominated by Birch woodland and scrub. This area is within the Mountlucas windfarm footprint and rehabilitation measures were targeted to re-wet parts of this section.

2) The remainder of the bog can be divided into two sections: a north western section and a south-western section. Two sections of bog to the west of the site were used for peat extraction until relatively recently (2019) and were dominated by bare peat.

North Western Section

This section of Mountlucas Bog is separated from the south-western section by a large drainage ditch running east-west. This area is dominated by large extent of re-wetted cutaway 'Bare peat (0-50% cover)' (BP), along with small patches of shallow surface water and some pioneer vegetation.

There are scattered patches of pioneering poor fen and some drier open habitats through this area developing with vegetation communities including 'Pioneer *Juncus effusus* community (poor fen)' (pJeff), 'Pioneer *Juncus bulbosus* community' (pJbulb) and '*Anthoxanthum-Holcus-Equisetum* community' (gAn-H-Eq). There is also a small wetland containing open water ('Permanent pools or lakes' or OW) and 'Pioneer *Juncus effusus* community' (pJeff). To the south-east there is some wet scrub and poor fen containing 'Pioneer *Juncus effusus* community' (pJeff), '*Anthoxanthum-Holcus-Equisetum* community' (gAn-H-Eq) and scrub categorised as 'Open *Betula*-dominated community' (oBir). There is a mature stand of *Betula-Salix* woodland (BirWD/WN7) in the south eastern margin of this section.

South Western Section

The eastern part of this area is dominated by re-wetted bare peat (BP), some patches of shallow surface water and some pioneer open habitats. Vegetation communities recorded in this area include 'Pioneer *Juncus effusus* community'(pJeff), 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang) and 'Open *Betula*-dominated community' (oBir). The central area is mostly re-wetted bare peat that has been colonised by pioneering open vegetation communities with some scrub vegetation developing close to the field drains.

In the extreme south of this section, close to the southern site boundary, wetter conditions exist. Pioneer poor fen and scrub vegetation is dominant. Vegetation communities include 'Open *Betula*-dominated community' (oBir), 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang) and 'Pioneer *Juncus effusus* community' (pJeff).

The western section is dominated by scrub with some pioneer open habitats. These areas are dominated by bare peat in the south. The central area contains scrub with pioneer open habitats and is quite wet in places. Vegetation communities present include pJeff, pioneer pTrig and gAn-H-Eq. The category '*Typha* community' (pTyh) is present in wetter areas and in field drains. The dogleg contains pJeff, pioneer pTrig and oBir.

It is too soon for habitats at Mountlucas to reflect post rehabilitation change or vegetation succession. Very little new pioneering vegetation is present in the rehabilitation extent in these bare peat areas. Some areas of the bog already have well established pioneer vegetation including poor fen and scrub. These habitats will continue to develop post rehabilitation.

Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas.

In conclusion the habitats largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of pioneer vegetation cover in the re-wetted parts of this site in the future.

Figure 2.15.2: Wetlands dominated by *Phragmites*-dominated community.

Figure 2.15.3: Grassland and wetland habitats at Mountlucas.

Figure 2.15.4: Pioneer open habitats forming in field drains.

Figure 2.15.5: Bare peat in the south of Mount Lucas with pioneer open habitats.

Vegetation Quadrats – Monitoring YR1

No vegetation quadrats were scoped in as part of habitat Monitoring and Verification at Mountlucas Bog.

Winter Birds – Monitoring YR1

No winter bird counts were scoped in as part of Monitoring and Verification at Mountlucas Bog.

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 2 no. transects (10 no. 200m sections) which were visited two times in the period June to July 2022 inclusive. See the figure in Appendix P2 titled '*Mountlucas Bog Ecology Transects'* for a detailed habitat map.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields, head lands or rail lines associated with former peat

extraction. Due to their location sampling results may include species which utilise the areas adjacent to these areas i.e. areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

Regarding visits the first and second visits were both outside their recommended period (Early April – mid-May for visit 1 and mid-May to Late June for Visit 2). Results are therefore interpreted as if only a visit 2 was effectively conducted (based on a survey date of June 01). On this basis it is acknowledged that some early breeding species may be omitted from the data. Species recorded in July only are treated as unconfirmed in the context of breeding - even if breeding was still possible. This includes Buzzard, Coal Tit, Great Tit, Lapwing and Long Tailed Tit referred to with the qualifier JO (July Only) below. These species are still listed in Species Richness estimates as there is some validity around their usage of cutaway during the study period.

Results- Species Richness

Species richness is presented as the total number of species recorded across all transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant. As noted above species recorded in July only are also included.

A total of 37 no. species were recorded, see Table 2.15.1. This included four BOCCI (Gilbert *et al.* 2021) Red listed species namely Black headed gull, Lapwing, Meadow Pipit, and Yellowhammer along with 6 no. BOCCI Amber listed species namely House Martin, Lesser Black backed Gull, Mallard, Skylark, Swallow and Willow Warbler. Remaining species were all Green listed apart from Pheasant which is not assigned a BOCCI status.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species per visit (E or L) or as the maximum count for the period April to June inclusive, see Table 2.15.1. This allows for future comparison with CBS trends which takes the same approach to index species. Maximum counts of greater than 20 individuals were recorded for a single species Mallard (n=23). Maximum counts of 10-19 individuals were recorded for five species, with the highest being Whitethroat (n=16) followed by Blackcap (n=15) & Willow Warbler (n=15) with maxima for Wren and Meadow Pipit of 14 each. A total of 31 species occurred at a maximum abundance of nine individuals or less.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Eighteen species considered associated with NON-OPEN habitats were recorded and eighteen species associated with OPEN habitats were recorded see Table 2.15.1. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were noted.

Discussion

Regarding species utilising Mountlucas bog in the 2022 breeding season it is notable that 10 of the total 37 species recorded (27%) are of conservation concern and are either Red or Amber BOCCI listed. Apart from Willow Warbler all Red or Amber listed species (n=9) are associated with open habitats. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009). Regarding Lapwing, which was recorded in July only we have not assigned definite breeding status, as the occurrence of 7 individuals in July may reflect dispersing birds from other breeding sites. Although Yellowhammer, which is Red listed, was recorded from onsite transects, it may associate more strongly with improved farmland located to the east of Mountlucas.

In conclusion the data presented here forms a baseline in respect of Mountlucas itself but also to inform further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway bogs (pre or post rehabilitation). No significant change in wintering bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Mountlucas, but measures have consolidated conditions for wetland habitats to continue to develop to support wintering bird species already using the site.

Table 2.15.1: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	23
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	15
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	1
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	1
BZ Buzzard *Buteo buteo*	Green	OPEN	0
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	8
CK Cuckoo *Cuculus canorus*	Green	OPEN	3
CT Coal Tit *Periparus ater*	Green	NON-OPEN	0
D. Dunnock *Prunella modularis*	Green	NON-OPEN	2
GT Great Tit *Parus major*	Green	NON-OPEN	0
H. Grey Heron *Ardea cinerea*	Green	OPEN	1
HC Hooded Crow *Corvus cornix*	Green	OPEN	3
HM House Martin *Delichon urbicum*	Amber	OPEN	6
J Jay *Garrulus glandarius*	Green	NON-OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	0
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	1
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	6
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	0
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	6
MA Mallard *Anas platyrhynchos*	Amber	OPEN	1
MH Moorhen *Gallinula chloropus*	Green	OPEN	1
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	14

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	1
PW Pied Wagtail *Motacilla alba*	Green	OPEN	2
R. Robin *Erithacus rubecula*	Green	NON-OPEN	7
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	9
S. Skylark *Alauda arvensis*	Amber	OPEN	4
SC Stonechat *Saxicola rubicola*	Green	OPEN	4
SL Swallow *Hirundo rustica*	Amber	OPEN	2
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	5
WH Whitethroat *Sylvia communis*	Green	OPEN	16
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	1
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	14
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	15
Y Yellowhammer *Emberiza citrinella*	Red	OPEN	3

Pollinators

No Pollinator counts were scoped in as part of Monitoring and Verification at Mountlucas Bog.

2.15.3 Surface Water Quality

Mountlucas bog has two surface water treatment outlets, one direct to the Figile River IE_SE_14F010300 and the other via the Daingean IE_SE_14D060200. Both outlets are monitored as part of EDRRS (SW11A & SW19) and a composite sampler has been installed on SW19. The location of these outlets are shown on Drawing No. BNM-DR-22-11-32 in Appendix P0.

Analysis over 5 years of the IPC licence environmental monitoring programme, indicates that recommended parameters like Suspended solids had an average of 4.83 mg/l with Ammonia averaging 0.394 mg/l, as per results below.

Table 2.15.2: Mountlucas Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sample Date	pH	SS	TS	Ammonia	TP	COD	Colour
Mountlucas	SW-11A	Q3 19	29/07/2019	7.9	5	456	0.41	0.07	31	45
Mountlucas	SW-19	Q3 19	30/07/2019	7.6	5	420	0.02	0.08	57	48
Mountlucas	SW-11A	Q1 18	21/03/2018	7.9	5	370	1.1	0.05	35	70
Mountlucas	SW-19	Q1 18	21/03/2018	7.8	5	304	0.68	0.05	61	122
Mountlucas	SW-11A	Q4 20	13/10/2020	7.9	6	408	0.125	0.05	46	269
Mountlucas	SW-19	Q4 20	14/10/2020	7.6	3	336	0.029	0.05	47	88

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 25 sampling events for this report, up to September 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with 3.4mg/l (SW11A) and 4mg/l (SW19). Similarly, Ammonia had an average of 0.222 mg/l, which is less than when the bog was in active production but with a slightly increasing trend.

Mountlucas rehabilitation commenced in June 2021 and since then overall trends in the two main water quality parameters, Suspended Solids and Ammonia, were shown to be slightly increasing during the period with no obvious clear relationship between rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there were some noticeable peaks in suspended solids during the Winter months.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

Also, pH can be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.76

Surface water monitoring for the period and associate graphs are in Appendix P3.

2.15.4 Flow monitoring

A flow monitoring probe is installed in Mountlucas Bog and this is discussed in more detail in Section 4 of this report.

2.15.5 Archaeology

This bog was not included in the National Monuments Service archaeological monitoring programme. One archaeological find was discovered and reported during the rehabilitation measures, this was a wooden togher/trackway extending from adjoining bog through Mountlucas bog, which was reported and protected from ongoing rehabilitation measures.

During the Archaeological Impact Assessment desk study, (OF018-182---- and OF018-184----) and RD23-3-1, RD23-2, RD14-1, RD14-3, RD23-3-7, RD23-3-3 and RD23-3-9, were preserved *in situ* and avoided by the rehabilitation works with a 20m buffer zone

2.15.6 Aerial Imagery / LiDAR

Mountlucas Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Mountlucas Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.16 Ummeras Bog

Ummeras Bog is located approximately 3 km North of Monasterevin and straddles the border between Co. Offaly to the north and Co. Kildare to the south. The Grand Canal is located to the east of the site. The Slate River flows to the north of the site and meets the Figile, where it then flows south to the west of Ummeras Bog to meet the Barrow. The area of the bog is 302 hectares. Bord na Móna started

to level and cut drains at Ummeras Bog in 1973. Sod peat moss was originally harvested in 1980 and then harvesting of milled moss peat began in 1989 and ceased in 2019.

Further information on the bog is available in the Ummeras Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation Commenced on Ummeras Bog in July 2021 and was 93% complete at the end June 2022.

2.16.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Ummeras bog. A total of 13 nests have been installed comprised of 5 deep wells and 13 Phreatic wells. Of these, 5 Phreatic wells have been instrumented with automated loggers, with a subset of the deep piezometers (1) instrumented with automated loggers. The location of these wells are shown on Drawing No. 22-06-32 in Appendix Q0. A total of four monitoring visits have been carried out to date at Ummeras bog as outlined in Appendix Q1 - Ummeras Bog - Hydrological Monitoring, with manual dipping completed in July 2021, January 2022, and logger dipping in September 2022. Monitoring will be ongoing at Ummeras bog over the next three years (2023, 2024, 2025). It is important to acknowledge the progress of works at Ummeras Bog. Several key drainage features that would have an impact on ground water levels have yet to be completed. It is envisaged that completion of these measures will have an impact on ground water levels generally within Ummeras bog.

A summary of manual readings is provided in Appendix Q1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were higher across most monitoring wells in summer 2022 compared to summer 2021. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data gathered from well UM_009_S shows the water levels were typically between 40-65cm below ground level throughout summer 2021, before increasing throughout autumn and winter 2021/22 and reaching a maximum of 44cm above ground surface. Water levels began to decline throughout summer 2022 but remained within 20cm of the ground surface at all times. This monitoring well is located within an area where Deep Peat Type 4 rehabilitation measures have been implemented demonstrating that these measures have been very effective in this area. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

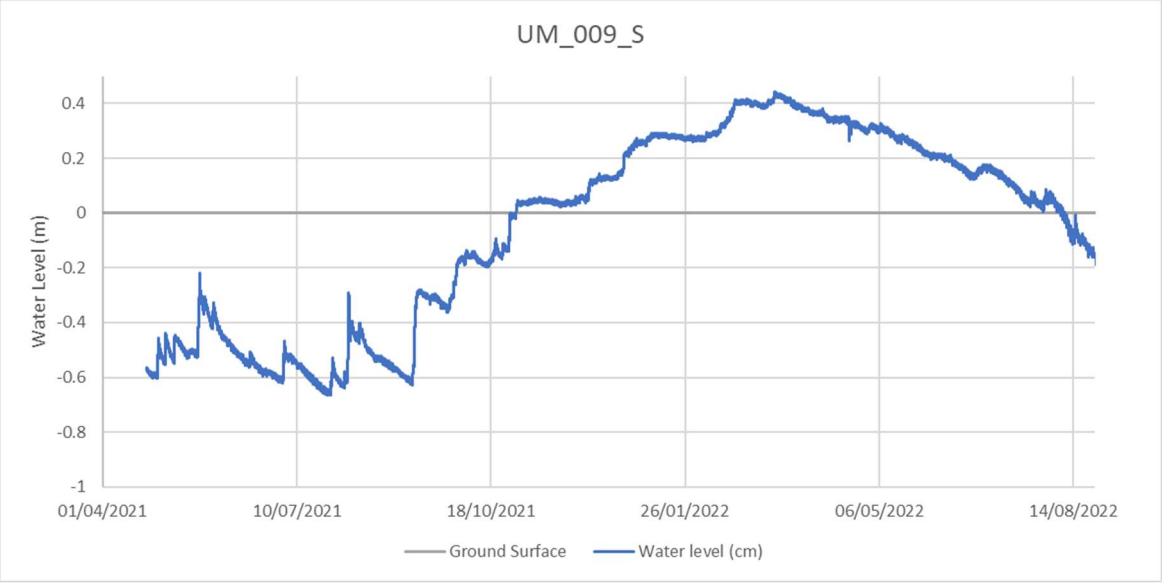

Figure 2.16.1: Hydrograph for monitoring well UM_009s

2.16.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Ummeras Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

The majority of Ummeras bog comprises re-wetted bare peat-dominated cutover bog. There has been limited recolonisation so far in the areas formerly used for peat extraction. There are frequent patches of shallow surface water. Pioneer vegetation is appearing with communities such as 'Pioneer *Juncus effusus* community'(pJeff), 'Pioneer *Juncus bulbosus* community' (pBulb) and 'Pioneer *Eriophorum angustifolium* community (Poor fen)' (pEang) poor fen communities starting to develop but overall vegetation cover is less than 5% cover. Further east there is some more vegetation cover here the peat is shallower and the poor fen habitat '*Carex rostrata* community' (pRos) appears as well.

Ummeras Bog has a mosaic of different overlapping environmental characteristics influenced by residual peat depths, sub-soils and hydrology. A significant part of the cutover bog is residual deep bare peat, which has not yet developed significant ecological indicator species relating to acidic water chemistry at present. Some sections already have ecological indicators of more alkaline ground-water influence and are beginning to develop poor fen vegetation.

A gravel ridge is present in the western side and is somewhat more elevated. This area is developing a typical dry cutaway vegetation community assemblage with 'Open *Betula*-dominated community'

(oBir) establishing along the old production drains, along with 'Pioneer *Juncus effusus* community' (pJeff) and some *Eriophorum angustifolium*' poor fen pioneer vegetation. Vegetation cover in this section is better developed (>50%). Some scattered *Eriophorum vaginatum* is also present but is rare/occasional in abundance.

In the north-east there are several 'fields' that were developed and cleared of vegetation, but not harvested extensively for milled peat. This area has developed extensive cover of the community 'Dry *Calluna* community' (dHeath). Other typical bog species including frequent *Cladonia* spp. lichen cover, *Hypnum jutlandicum* and *Campylopus introflexus* also occur. There is occasional cover of *Sphagnum papillosum* and *S. capillifolium* present on the high bog surface, but these are typically dry. *Sphagnum cuspidatum* has also been recorded in some of the former drains. These drains have now been blocked.

Rehabilitation was carried out at Ummeras bog in 2021. It is too soon for habitats at Ummeras to reflect post rehabilitation change or succession. Approximately 90% of Ummeras remains as re-wetted bare peat and scattered patches of shallow surface water. The habitats already present will continue to develop post rehabilitation.

Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas.

In conclusion the habitats recorded in 2021/2022 largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of pioneer vegetation cover in the re-wetted parts of this site in the future.

Figure 2.16.2: Example of extensive areas of bare peat.

Figure 2.16.3: Heather dominated vegetetaion and scrub.

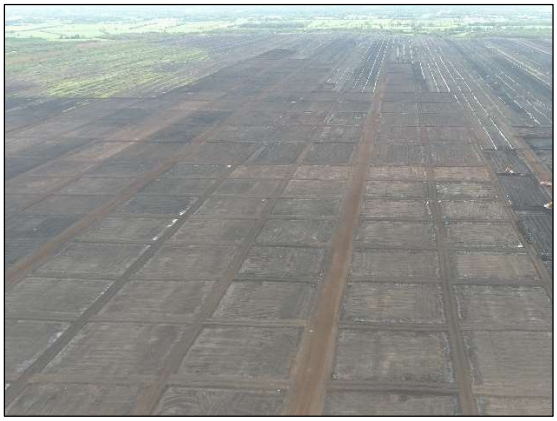

Figure 2.16.4: Example of deep peat cell bunding.

Figure 2.16.5: Example of typical pioneering dry cutaway vegetation.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Ummeras bog in June 2021 in accordance with agreed EDRRS Monitoring and Verification. 5 no. quadrats were employed.

Constraints

Several quadrats were taken from representative areas of bare peat within the site. These areas were then significantly modified during the implementation of the EDRRS rehabilitation measures i.e. creation of deep peat cell bunding. However, they are representative of the environmental conditions pre rehabilitation. These locations were again visited post implementation of the rehabilitation measures in July 2022. As suspected, these areas still retained significant areas of bare peat, with no significant vegetation changes from the baseline i.e. bare peat.

Results

See Table 1 of Appendix Q2. Quadrats Q1, Q2 and Q3 were dominated by bare peat (90-100% cover), with few plants recorded (small numbers of individual plants, such as *Eriophorum angustifolium, Eriophorum vaginatum* or *Typha latifolia* were noted – typically spreading from adjacent drains). Quadrat Q4 was taken on a small area of remnant bog (PB1) where drain blocking was planned. This area

was dry and dominated by leggy Calluna vulgaris. Although Sphagnum species were noted in the wider area, the bryophyte layer was dominated by *Hypnum jutlandicum*. Quadrat Q5 was located in an area of Dry cutaway, on shallow peat, and has been out of production for a few years. Consequently, this area supported a greater cover and diversity of plant species (typical of this feature) although was dominated by bare peat.

Discussion

As with habitats the quadrats reflect the baseline conditions pre-rehabilitation. Post-implementation of the rehabilitation measures, there is likely to be change within some quadrats, particularly in areas where deep peat measures (cell bunding) has been undertaken, and percentage cover of standing water may have increased. There will be less change in areas located on remnant bog or areas of dry cutaway. Further time is required before significant changes in vegetation composition is likely to be recorded.

Figure 2.16.6: Quadrat Q5

Figure 2.16.7: Quadrat Q3

Winter Birds – Monitoring YR1

Method

Fixed counts, following I-WeBS methods, were used to count wintering waterfowl at Ummeras. A total of six counts were undertaken at monthly intervals, covering the period September 2021 to February 2022 inclusive.

Constraints

No constraints were noted. In September, some EDRRS activity was still ongoing in the northeast corner of the bog. However, this is not considered to have affected the count. Similarly, in October, 2 scramblers appeared at the bog near dusk causing localised disturbance after the count. It did not affect the survey effort.

Results – Species Richness

A total of seven water bird species were recorded across all surveys. Four of these were BoCCI Red listed species (Gilbert *et al.* 2021) namely Golden Plover, Snipe, Pintail and Lapwing. Mute Swan was the only Amber listed species.

Results – Abundance

The total counts for each visit across the winter period is presented in Table 2.16.1. It is clear that the site is only used intermittently by wintering waterfowl species and this is likely due to the extensive areas of bare peat providing little shelter or feeding opportunities. In addition, there is limited established wetland vegetation, and this associated macroinvertebrates. The highest count was for Golden Plover (n=2,800). This species was only recorded using the site on a single visit. It is considered likely that the species was opportunistically using the site for roosting while foraging in the wider landscape.

Results – Habitat Associations

Most of the wintering wildfowl records were associated with a small wetland located in the southeast corner of the bog. The flock of 2800 golden plover was recorded within the south of the bog roosting on constructed berms within the recently rehabilitated peatland. A number of individuals were also observed washing in the small pools.

Snipe was found to associate more with vegetated drains at the bog margins. However, this is also likely to reflects the species propensity to flush from such habitats when approached during the survey. Snipe were the only species recorded in more than one month.

Discussion

Overall species richness is considered medium during the period studied. This reflects the baseline bog condition, dominated by bare peat, which offers little or no foraging opportunities for many species of water bird. Roosting opportunities are provided for Golden plover, Lapwing and Snipe, which may also forage onsite, and Golden Plover abundance can exceed the All Ireland threshold for National Importance (920). Over time, as supporting wetland habitats develop at Ummeras it is expected that it may also become a refugium for a diversity of wintering wildfowl species such as those recorded during the 2021-22 winter months.

Post rehabilitation and associated revegetation, Ummeras may contribute to further habitat for a variety of wintering bird species of conservation concern and support the conservation objectives for European Site located in the wider landscape. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds. No significant change in wintering bird species richness and abundance can be attributed to the peatland rehabilitation so far in the re-wetted section at Ummeras, but measures have consolidated conditions for peatland and wetland habitats to continue to develop to support wintering bird species already using the site.

Table 2.16.1: Winter 2021/22 – Monitoring YR1 IWeBS Survey Results

Species	BoCCI STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Maximum
SN Snipe *Gallinago gallinago*	Red	0	0	0	14	2	0	14
GP Golden Plover *Pluvialis apricaria*	Red	0	0	2,800	0	0	0	2,800
L. Lapwing *Vanellus vanellus*	Red	0	0	1	0	0	0	1
MS Mute Swan *Cygnus olor*	Amber	0	0	0	2	0	0	2
H. Grey Heron Ardea cinerea	Green	0	0	0	0	0	1	1
PT Pintail *Anas acuta*	Red	0	0	0	0	0	4	4

RP Ringed Plover *Charadrius hiaticula*	Green	0	0	0	0	0	6	6

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 2 no. transects were visited four times in the period May to August inclusive of 2022. Breeding waders' surveys were also undertaken on the same dates and followed the same routes. See figure in Appendix O2 titled '*Ummeras Bog Ecology Transects'* for transect routes.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields or headlands associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to transects but which are not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

Regarding visits the first and last visits were both outside their recommended period (April - July). On this basis it is acknowledged that some early breeding species may be omitted from the data. In addition, species recorded in July/August CBS only are treated with a degree of caution in respect of breeding status. Annual Relative Abundance only includes maxima for the period April to June inclusive as per the master text on materials and methods. Waders are treated separately as there was a bespoke breeding wader survey. All species are still listed in Species Richness estimates as there is some validity around their usage of cutaway during the study period.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 43 no. species were recorded, see Table 2.16.2. This included four BOCCI (Gilbert *et al.* 2021) Red listed species Black headed gull, Curlew, Meadow Pipit, and Snipe along with 11 no. BOCCI Amber listed species namely Greenfinch, Lesser Black backed gull, Linnet, Mallard, Mute swan, Ringed plover, Skylark, Swallow, Sand Martin, Starling and Willow Warbler. Remaining species (n=28) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

A bespoke breeding waders survey was undertaken in 2022, data on breeding pairs is herein presented in line with an interpretation following the O'Brien and Smith (1992) method for censusing lowland breeding wader populations. On this basis 2 pairs of Ringed Plover bred onsite in 2022. Ringed Plover adults with a single chick were observed on August 22nd. We note that Curlew were recorded in May and June CBS visits however did not breed on site, and observations may be of passage or nearby breeding birds. In addition, Snipe were recorded in July and August CBS visits but this is considered too late in the breeding season to assign breeding status.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species across visit #1, #2, or within the period April to June inclusive, see Table 2.16.2. This allows for future comparison with CBS trends.

Maximum counts of greater than 40 individuals were recorded for a single species, Meadow Pipit. Wren abundance was second highest at 24 individuals. Maximum counts of between 10-19 individuals were recorded for Willow Warbler (n=18), Blackbird (n=13), Redpoll (n=13) and Robin (n=10). Maximum abundance estimates for all other species (n=37) was in the order of 0-9 individuals.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Twenty species considered associated with NON-OPEN habitats were recorded and twenty two species associated with OPEN habitats were recorded see Table 2.16.2. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were observed.

Discussion

Of the four Red listed species recorded, three (Black headed gull, Curlew and Snipe) are associated with open habitats targeted for rehabilitation in the form of rewetting and would be expected to gain from measures intended to effectively create wetlands. Meadow pipit would be associated with drier habitats or those areas targeted for fertiliser application such as high fields. Eleven Amber listed species were recorded however abundance was low (0-9) for all except Willow Warbler (ARA=18). Overall, however the total number of species either Red or Amber listed was 15 suggesting the potential importance of Ummeras for species of conservation concern in one form or other, either foraging or breeding or for use as a refugium.

Breeding waders were dominated by Ringed Plover. Two pairs attempted to breed and at least one pair produced chicks. We note that some species recorded utilising Ummeras such as Lesser Black backed Gull, along with Grey Heron, Corvids such as Raven and Raptor species such as Buzzard have the potential to predate breeding wader nests and young. Curlew were recorded utilising the site but did not breed onsite. There are nearby Curlew breeding territories (primarily on wet grassland habitats) within the hinterland of Ummeras and rehabilitation at Ummeras may benefit these through the provision of additional foraging or roosting opportunities. In particular regard to Curlew we would recommend that any further site afteruse take particular cognisance of minimising the potential for disturbance.

Regarding habitat associations 51% of species recorded are more associated with open habitats. Many of these species breed on or frequently visit open areas of cutaway to forage. Open habitat species comprise 87% of Red and Amber listed species (13 no. in total). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland

2009), and this is borne out at Ummeras. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway or rehabilitated cutaway bogs and establishes the potential for Ummeras to support the conservation of several scarce or declining species. No significant change in breeding bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Ummeras, but measures have consolidated conditions for wetland and peatland habitats to continue to develop to support breeding bird species using the site.

Table 2.16.2. 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	13
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	5
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	6
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	2
BZ Buzzard *Buteo buteo*	Green	OPEN	1
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	8
CK Cuckoo *Cuculus canorus*	Green	OPEN	1
CT Coal Tit *Periparus ater*	Green	NON-OPEN	1
CU Curlew *Numenius arquata*	Red	OPEN	2
D. Dunnock *Prunella modularis*	Green	NON-OPEN	0
GO Goldfinch *Carduelis carduelis*	Green	OPEN	0
GR Greenfinch *Chloris chloris*	Amber	OPEN	4
GT Great Tit *Parus major*	Green	NON-OPEN	2
H. Grey Heron *Ardea cinerea*	Green	OPEN	5
HC Hooded Crow *Corvus cornix*	Green	OPEN	9
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	2
LI Linnet *Carduelis cannabina*	Amber	OPEN	1
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	13
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	5
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	1
MA Mallard *Anas platyrhynchos*	Amber	OPEN	5
MG Magpie *Pica pica*	Green	NON-OPEN	0
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	41
MS Mute Swan *Cygnus olor*	Amber	OPEN	6
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	0
PW Pied Wagtail *Motacilla alba*	Green	OPEN	6
R. Robin *Erithacus rubecula*	Green	NON-OPEN	10
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	4
RN Raven *Corvus corax*	Green	OPEN	7
RP Ringed Plover *Charadrius hiaticula*	Amber	OPEN	7
S. Skylark *Alauda arvensis*	Amber	OPEN	3
SC Stonechat *Saxicola rubicola*	Green	OPEN	2
SG Starling *Sturnus vulgaris*	Amber	NON-OPEN	9
SL Swallow *Hirundo rustica*	Amber	OPEN	3

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
SM Sand Martin *Riparia riparia*	Amber	OPEN	9
SN Snipe *Gallinago gallinago*	Red	OPEN	0
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	9
WH Whitethroat Sylvia communis	Green	NON-OPEN	7
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	8
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	24
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	18

Pollinators

Methods

The transect at Ummeras is 2km in length. All surveys were completed between 10:30am and 02:30pm, when the temperature was at least 13°C and during good weather conditions. Monthly counts across the period May 2022 to September 2022 (5 in total) are herein reported. See figure in Appendix O2 titled '*Ummeras Bog Ecology Transects'* for transect routes.

Constraints

No constraints were identified during the survey. Weather conditions were optimal during all the surveys.

Results – Species Richness

A total of four species of butterfly were recorded namely Green-veined White, Meadow Brown, Ringlet and Speckled wood. In addition to butterflies, White-tailed Bumblebee (n=15), Red-tailed Bumblebee (n=8), Western Honeybee (n=6), Orange-legged Furrow Bee (n = 1), Four-spotted Chaser (n = 4), Common Darter (n = 2), Common Hawker (n = 1), Emerald Damselfly (n = 1) and Black-tailed Skimmer (n = 1) were also recorded during the surveys.

Results – Abundance

Generally low numbers were recorded, with a total of 11 individual butterflies recorded during the surveys. Green-veined White occurred in the highest abundance (5 overall), with the highest abundance recorded during the July survey (3). The highest abundance overall per month was recorded in July. The lowest was in May, with no species recorded.

Results – Habitat Associations

The majority of the transect crosses bare peat, with some pioneering vegetation in the wider area of the transect. In general, little or no pollinator activity was clearly associated with bare peat or recently rehabilitated bare peat areas. Species recorded on bare peat sections of the transect were primarily traversing the transect to nearby vegetated drains, as insufficient vegetation is present on the transect to attract feeding pollinators.

Discussion

The baseline scenario for Ummeras still reflects habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators. It is possible species richness and abundance may increase in future surveys along the transect route when the rehabilitated area begins

to revegetate. The effects of fertiliser application in particular to headlands and high fields may increase the rate of colonisation by some species.

Table 2.16.3: 2022 – Monitoring YR1 Pollinator Survey Results

Species	May	June	July	August	September	Total
Green-veined White *Pieris napi*	0	1	3	1	0	5
Meadow Brown *Maniola jurtina*	0	0	1	2	0	3
Speckled Wood *Pararge aegeria*	0	0	1	0	0	1
Ringlet *Aphantopus hyperantus*	0	0	1	1	0	2
Total	**0**	**1**	**6**	**4**	**0**	**11**

2.16.3 Surface Water Quality

Ummeras bog has three surface water treatment outlets to the Slate River IE_SE_14S010300 and the Figile River IE_SE_14F010600. Two of these outlets are monitored as part of EDRRS (SW4 & SW6) and a composite sampler is installed on SW4. The locations of these outlets are shown on Drawing No. 22-06-32 in Appendix Q0.

Analysis over 5 years of the IPC licence environmental monitoring programme, indicates that recommended parameters like Suspended solids had an average of 4.27 mg/l with Ammonia averaging 0.97 mg/, as per results below.

Table 2.16.4: Ummeras Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
Ummeras	SW-4	Q3 20	12/08/2020	7.3	2	233	2.01	0.05	109	408
Ummeras	SW-5	Q3 20	12/08/2020	7.7	2	374	0.108	0.07	74	223
Ummeras	SW-6	Q3 20	12/08/2020	6.5	2	226	1.17	0.05	134	680
Ummeras	SW-6A	Q3 20	12/08/2020	6.7	2	190	0.641	0.05	118	438
Ummeras	SW-5	Q3 19	11/07/2019	7.1	5	204	0.02	0.11	77	489
Ummeras	SW-6	Q3 19	11/07/2019	7	6	222	0.02	0.07	77	485
Ummeras	SW-6A	Q3 19	11/07/2019	7.5	5	230	1.2	0.23	135	253
Ummeras	SW-4	Q3 19	11/07/2019	7.7	5	300	0.54	0.09	96	169
Ummeras	SW-5	Q1 18	22/03/2018	7.7	5	265	1.4	0.05	64	207
Ummeras	SW-6	Q1 18	22/03/2018	7.5	5	198	0.7	0.05	69	296
Ummeras	SW-6A	Q1 18	22/03/2018	7.8	5	264	1.4	0.05	48	138
Ummeras	SW-4	Q1 18	22/03/2018	7.6	5	270	1.5	0.05	71	270
Ummeras	SW-6	Q1 17	14/03/2017	7.4	5	248	2.5	0.05	90	332
Ummeras	SW-6A	Q1 17	14/03/2017	7.8	5	294	1.3	0.05	100	255
Ummeras	SW-4	Q4 16	24/11/2016	7.4	5	180	0.11	0.05	91	142

Monthly EDRRS baseline monitoring commenced in October 2020, which gave 24 sampling events for this report, up to September 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, 4.3 mg/l (SW4) and 3.7 mg/l (SW6). Similarly, Ammonia had an average of 0.851 mg/l, was slightly less than when the bog was in active production but with a slight increasing trend at this stage in the monitoring programme for Suspended Solids, with a sharp decline in Ammonia.

Ummeras rehabilitation commenced in July 2021 and since then overall trends are generally in a positive trajectory with a clear relationship between rainfall and concentration of run-off at this

location. During this period with significant drain blocking and cell formation, there were some noticeable peaks in suspended solids, but below the emission limit value.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.5.

Surface water monitoring for the period and associate graphs are in Appendix Q3

[redacted]

While the data did indicate a slight upward trend in suspended solids in February 2022 during the installation of flow control from each cell, this reduced back down to normal levels post the installation works. In relation to Ammonia during the same period, the data continues to indicate a continuing downward trajectory in concentration.

[redacted]

[redacted]

2.16.4 Archaeology

This bog was included in the National Monuments Service archaeological monitoring programme carried out by Archaeological Management Solutions (AMS).

Ummeras Bog, Co. Kildare/Co. Offaly was visited on five occasions during the rehabilitation works (12 August 2021, 16 September 2021, 04 November 2021, 13 January 2022, and 25 January 2022). The primary purpose was to monitor the ongoing rehabilitation works including cell formation and drain blocking and to inspect the peat fields and drain sections across the bog for any possible archaeological features. Conditions under foot varied from dry and stable from August to October but gradually became wetter and softer from November to January resulting in raised water levels in many of the cells and drains. Drainage pipes and/ or plastic sheet piles were subsequently placed in the berms of existing cells throughout the bog to insure a water level beneficial to sphagnum moss growth. No new archaeological features of significance were recorded.

No new archaeological finds were found and reported during the rehabilitation measures.

During the initial Archaeological Impact Assessment desk study, there were no known surviving archaeological sites in the rehabilitation area. Several archaeological finds from the bog have been reported to the National Museum of Ireland over the years.

2.16.5 Aerial Imagery / LiDAR

Ummeras Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in September 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Ummeras Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.17 Derrycashel Bog

Derrycashel bog is located in Co. Roscommon along the River Shannon, circa 5 km north of Lanesborough. The area of the bog is 384 hectares. Derrycashel bog is a relatively old production bog and was in production from 1951 until 2018. Further information on the bog is available in the Derrycashel Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation measures commenced in this bog in November 2021 and was 89% complete at the end June 2022.

2.17.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Derrycashel bog. A total of 16 nests comprised of 16 Phreatic wells were installed, 8 Phreatic wells have been instrumented with automated loggers. The location of these nests are shown on Drawing No. BNM-DR-22-18-32 in Appendix R0. A total of four monitoring visits have been carried out to date at Derrycashel bog as outlined in Appendix R1 - Derrycashel Bog - Hydrological Monitoring, with manual dipping completed in August 2021, February 2022, and logger dipping in August 2022. Monitoring will be ongoing at Derrycashel bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix R1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were slightly higher at most monitoring wells in summer 2022 compared to summer 2021, although there are some exceptions with lower water levels recorded in summer 2022. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data gathered from well DCa_003S demonstrates a significant change to the hydrological regime following rehabilitation. There is a rapid increase in water levels in September 2021 coinciding with the implementation of rehabilitation measures, with water levels rising to within 10cm of the ground surface over winter 2021/22 before dropping during summer 2022. However, despite water levels dropping to 35cm below ground level, this remains significantly higher than during summer 2021. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project

hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

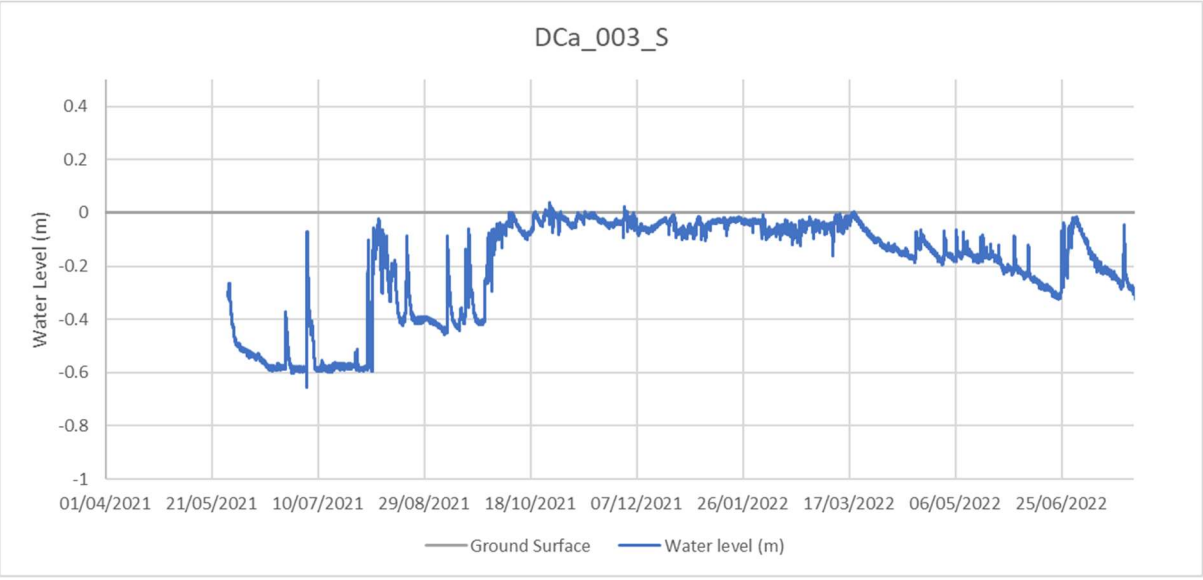

Figure 2.17.1: Hydrograph for monitoring well DCa_003s

2.17.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Derrycashel Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Derrycashel bog is a relatively old cutaway bog. It formerly had pumped drainage. The majority of the site has shallow peat or exposed sub-soil and now has pioneer vegetation or has developed extensive wetlands as water levels have risen recently. The topographical basin in Derrycashel is subject to winter inundation. Large portions of the former production area have formed wetland habitats with open water and mosaics of emergent wetland vegetation. Emergent communities forming large stands in the open water include '*Schoenoplectus* community' (pSch), '*Phragmites australis* community' (pPhrag), '*Typha* community' (pTyp) with small stands of pioneer '*Carex rostrate* community' (pRos) also present.

Stands of scrub dominated by willow (mainly *Salix cinerea/Salix aurtia*) have formed north of the central railway line in low lying basins with standing water present. On higher ground more typical dry

birch scrub has formed - open/closed *Betula*-dominated community (oBir/cBir) - with an understory typically formed by '*Molinia caerulea* dominated community' (gMol), 'Pioneer *Juncus effusus* community' (pJeff) or 'Dry *Calluna* community' (dHeath).

The most recent milled industrial peat production was mainly confined to peripheral areas along the southern and eastern margins, and bare peat remains in these areas, as well as along headlands and travel passes. The communities 'Pioneering *Eriophorum angustifolium* community (poor fen)' (pEang) and 'Pioneer *Juncus effusus* community' (pJeff) are beginning to colonise the bare peat. These communities broadly correspond to *Eriophorum angustifolium*-bare peat cutover bog group (BP2) (Smith and Crowley, 2020).

The longest established cutaway vegetation is located in the south of the site, formed over a glacial mound. This relatively dry elevated area is developing a mosaic of Birch Woodland (WN7), and Birch Scrub (WS1) at various successional stages. Communities include 'Closed Betula-scrub community (C)' (cBir), 'Open *Betula*-dominated community (B)' (oBir). Taller more mature Birch generally occurs along the drains, with open/closed/emergent Birch scrub, and dense pioneering *Juncus effusus* (pJeff) vegetation and patches of open bare peat occurring in mosaics in between. 'Dry *Calluna* community' (dHeath) dominated by dry Heather has developed, at the highest part of this mound, with some emergent Birch (eBir). This area is surrounded by the community '*Betula*-*Salix* woodland' (BirWD). Further areas of Birch scrub (WS1) occur north-east of the central railway line, with open/emergent *Betula* dominated community (oBir/eBir) forming stands on drier ground. An exposed gravel mound occurs in this part of Derrycashel, vegetated by the community '*Tussilago*-dominated community' (DisCF).

Marginal raised bog (PB1) occurs along the eastern and northern margins of Derrycashel. Pitcher Plant (*Sarracenia purpurea*) is extensive throughout the high bog in along the eastern boundary.

Derrycashel has a mosaic of environmental conditions with variable residual peat depths, sub-soils and a varied topography. On the cutaway wetland areas, formed in the topographical basins, there are widespread indicators of shallow peat and 'fen' influence on the natural recolonization of vegetation across the site. Areas of deep residual bare peat (on the high fields and remnant raised bog along the eastern margins) have ecological indicators of more acidic water chemistry present with frequent Heather. *Sphagnum* was occasionally recorded in high bog remnants, although infrequently.

Rehabilitation was carried out at this Bog in 2021. It is too soon for habitats at Derrycashel to reflect significant post rehabilitation change or vegetation/habitat succession. However, water levels across the site have changed significantly due to the re-wetting.

Some areas of the bog already have well established pioneer vegetation including Reedbeds, fen and scrub. Wetland vegetation was already developing in response to reduced drainage. The habitats already present will continue to develop post rehabilitation. The area recently used for peat extraction remains as bare peat with almost no fresh pioneering vegetation.

In conclusion the habitats recorded in 2022 largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of wetland development in the re-wetted parts of this site in the future.

Figure 2.17.2: Open water north of the central railway line.

Figure 2.17.3: Cutaway (PB4) with bare peat and pioneering open habitats and scrub developing.

Figure 2.17.4: Open water in the west of Derrycashel.

Figure 2.17.5: Exposed gravel mound occurs in the northern part of Derrycashel, vegetated by a Tussilago-dominated community (DisCF).

Vegetation Quadrats – Monitoring YR1

No vegetation quadrats were scoped in as part of habitat Monitoring and Verification at Derrycashel Bog.

Winter Birds – Monitoring YR1

Method

Counts were carried out in the period September-December 2021 inclusive and in January and February of 2022 (6 no. in total) and generally spanned the period from mid-morning to sunset. All counts were carried out in conditions good for recording birds, with no rain and good visibility. In one instance (October of 2021) additional water bird data from a dusk survey for roosting Hen Harrier has been included in the results.

Constraints

Significant parts of Derrycashel are subject to seasonal inundation. This limited access to the entirety of the site on several visits. When possible, this was counteracted by use of an elevated position to scan the wetlands on site using a telescope. Unauthorised shooting was encountered in one instance (December of 2021).

Results – Species Richness

A total of thirteen water bird species were recorded across all surveys. Three of these were BOCCI (Gilbert *et al.* 2021) Red listed species namely Golden Plover, Snipe and Shoveler. Six Amber listed species were recorded namely Common Sandpiper, Mallard, Mute Swan, Teal, Whooper Swan and Coot.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.17.1 and was highest for Teal (n=9) however this was strongly influenced by a peak of 33 recorded in September of 2021. Mean abundance was second highest for Whooper Swan (n=5). A peak of 16 was noted for this species in October of 2022 and the species was present on five of six counts.

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Derrycashel Bog. Many of the species are water obligates including Mallard, Teal, Shoveler, Coot and Wigeon. This reflects the open waterbodies across Derrycashel over most of the winter period. Species such as Snipe were recorded from wetlands onsite and Golden Plover (in low numbers) utilise bare peat areas for roosting. It is notable that Whooper Swan may associate more with the site during nocturnal hours than the data presented here suggests.

Discussion

The location of Derrycashel Bog on the River Shannon floodplain and the resulting annual cycle of inundation generally influences the water bird species richness onsite (considered medium), hence the occurrence of several species of conservation concern (Red or Amber listed species comprise 75% of the overall species recorded).

Regarding abundance however it is interesting that Whooper Swan were recorded night roosting at Derrycashel in November of 2021; further studies around dawn and dusk may support an evaluation that Derrycashel is more important as a night time refugium than a daytime feeding or roosting centre (certainly for this Annex I species) than the data might otherwise suggest. Further studies, including stratified dawn or duck counts might provide further resolution.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds at Derrycashel. We would recommend that further monitoring is stratified to sample further roosting activity. No significant change in wintering bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Derrycashel, but measures have consolidated conditions for wetland habitats to continue to develop to support wintering bird species using the site.

Table 2.17.1: 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Max
CS Common Sandpiper *Actitis hypoleucos*	Amber	1	0	0	0	0	0	0	1
MA Mallard *Anas platyrhynchos*	Amber	7	9	15	7	0	5	7	15
MS Mute Swan *Cygnus olor*	Amber	2	2	0	4	4	0	2	4
T. Teal *Anas crecca*	Amber	33	0	16	1	1	0	9	33
WN Wigeon *Anas penelope*	Amber	0	4	0	0	0	0	1	4
WS Whooper Swan *Cygnus cygnus*	Amber	0	16	8	4	4	0	5	16
CO Coot *Fulica atra*	Amber	2	0	0	0	0	0	0	2
H. Grey Heron *Ardea cinerea*	Green	2	2	0	0	0	0	1	2
MH Moorhen *Gallinula chloropus*	Green	3	4	0	0	0	0	1	4
WA Water Rail *Rallus aquaticus*	Green	0	1	0	1	0	0	0	1
GP Golden Plover *Pluvialis apricaria*	Red	0	0	0	20	0	0	3	20
SN Snipe *Gallinago gallinago*	Red	2	2	0	4	0	1	2	4
SV Shoveler *Anas clypeata*	Red	5	0	0	0	0	0	1	5

Breeding Birds – Monitoring YR1

Methods

An early (April to mid-May) and late (mid-May to late June) season visit was conducted. The early season visit was carried out on April 26, 2022 and covered the period 08:10am to 08:35am. Conditions were amenable to recording birds with zero cloud cover, zero wind and zero rain. Visibility was good. The late season visit took place on June 07th, 2022 and covered the period 08:00am to 08:45am. Conditions were amenable with no rain. Cloud cover was 100% and there was zero wind, with good visibility. See the figure in Appendix R2 titled '*Derrycashel Bog Ecology Transects'* for transect route information.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields or rail lines associated with former peat extraction. Due to their location sampling results may include species which utilise areas not subject to rehabilitation. Where relevant this is further addressed in the Discussion section. There were no constraints noted for the surveys described in this section.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant

A total of 31 no. species were recorded, see Table 2.17.2. This included four BOCCI (Gilbert *et al.* 2021) Red listed species Black-headed Gull, Lapwing, Meadow Pipit and Snipe along with 7 no. BOCCI Amber listed species namely Cormorant, Coot, Mallard, Swallow, Sand Martin, Teal and Willow Warbler. Remaining species (n=21) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species per visit (E or L) or as the maximum count for the period April to June inclusive, see Table 2.17.2. This allows for future comparison with CBS trends which takes the same approach to index species. A maximum count of greater than 50 individuals was recorded for one species Willow Warbler (n=53). Counts numbering 20-50 individuals were made in respect of Robin (n=38), Wren (n=27) and Blackbird (n=25). Remaining species occurred in abundance estimates of 19 or less individuals.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Thirteen species considered associated with NON-OPEN habitats were recorded and seventeen species associated with OPEN habitats were recorded see Table 2.17.2. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were recorded.

Discussion

All Red listed species recorded, Black-headed Gull, Lapwing, Meadow Pipit and Snipe are associated with open habitats targeted for rehabilitation in the form of rewetting, and would be expected to gain from measures intended to effectively create wetlands or increasingly vegetated bare peat (in the case of Meadow Pipit) . Current abundance estimates are low however for these species (ARA range 3-6) reflecting the present habitats at Derrycashel, which comprise largely either open water or pioneering scrub and woodland. Of the seven Amber listed species, 6 are associated with open habitats although abundance is similarly low (ARA range 1-17). Amber listed species diversity particularly reflects a preference for water bodies in respect of species such as Cormorant, Coot, Teal and Mallard. Overall, the total number of species either Red or Amber listed was 11 of which 10 are associated with open habitats. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this is reflected in our findings at Derrycashel.

Overall relative abundance was dominated by the commoner species associated with woodland and scrub such as Willow Warbler, Robin, Wren, and Blackbird (ARA range 25-53). This reflects the proportion of Derrycashel which is currently vegetated, although we note the detection rate of these species may be increased by the proximity of suitable breeding habitat to the rail lines used for transects. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutaway bogs, and in the case of Derrycashel highlights the potential importance of open water bodies onsite.

No significant change in breeding bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Derrycashel, but measures have consolidated conditions for wetland habitats to continue to develop to support breeding bird species using the site.

Table 2.17.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	25
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	18
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	2
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	4
CA Cormorant *Phalacrocorax carbo*	Amber	OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	19
CK Cuckoo *Cuculus canorus*	Green	OPEN	1
CO Coot *Fulica atra*	Amber	OPEN	4
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
H. Grey Heron Ardea cinerea	Green	OPEN	2
HC Hooded Crow *Corvus cornix*	Green	OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	6
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	17
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	6
MA Mallard *Anas platyrhynchos*	Amber	OPEN	17
MG Magpie *Pica pica*	Green	NON-OPEN	2
MH Moorhen *Gallinula chloropus*	Green	OPEN	2
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	3
R. Robin *Erithacus rubecula*	Green	NON-OPEN	38
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	5
SC Stonechat *Saxicola rubicola*	Green	OPEN	1
SL Swallow *Hirundo rustica*	Amber	OPEN	7
SM Sand Martin *Riparia riparia*	Amber	OPEN	1
SN Snipe *Gallinago gallinago*	Red	OPEN	3
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	1
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	2
T. Teal *Anas crecca*	Amber	OPEN	4
WH Whitethroat *Sylvia communis*	Green	NON-OPEN	15
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	3

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	27
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	53

Pollinators

No Pollinator surveys were scoped in as part of habitat Monitoring and Verification at Derrycashel Bog

2.17.3 Surface Water Quality

Derrycashel bog has four treated surface water outlets to the Feorish IE_SH_26F030400 and eventually the Shannon Upper IE_SH_26S021600. One of these outlets is monitored as part of EDRRS (SW16) and this location is shown on Drawing No. BNM-DR-22-18-32 in Appendix R0.

Analysis over 5 years of the IPC licence environmental monitoring programme, indicates that relevant parameters like suspended solids had an average of 5.37 mg/l with Ammonia averaging 0.355mg/l, as per results below.

Table 2.17.3: Derrycashel Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
Derrycashel	SW-13	Q2 18	30/04/2018	8	5	380	0.11	0.05	53	198
Derrycashel	SW-14	Q2 18	30/04/2018	7.6	5	206	0.06	0.05	58	423
Derrycashel	SW-15	Q2 18	02/05/2018	8.2	5	392	0.08	0.05	53	99
Derrycashel	SW-16	Q2 18	02/05/2018	7.7	5	258	0.63	0.05	107	283
Derrycashel	SW-13	Q3 13	09/09/2013	6.8	5	136	0.29	0.16	91	180
Derrycashel	SW-14	Q4 13	25/11/2013	4.8	5	154	0.21	0.05	129	383
Derrycashel	SW-15	Q4 13	25/11/2013	6.6	5	172	1.1	0.05	71	184
Derrycashel	SW-16	Q4 13	25/11/2013	7.7	8	358	0.36	0.05	50	92

Monthly EDRRS baseline monitoring commenced in September 2020, which gave 25 sampling events for this report, up to August 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 3.9mg/l. Similarly, Ammonia had an average of 0.181 mg/l, which is less than when the bog was in active production and is trended downwards.

Derrycashel rehabilitation commenced in November 2021 and since then overall trends remained unchanged during the period in relation to suspended solids with some clear relationship between rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained

peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 6.98.

Surface water monitoring for the period and associate graphs are in Appendix R3

2.17.4 Archaeology

Derrycashel bog was not included in the National Monuments Service archaeological monitoring programme. No archaeological finds were discovered and reported during the rehabilitation measures.

During the Archaeological Impact Assessment desk study, there was known extant archaeological material defined in Derrycashel Bog, which needed to be avoided by the rehabilitation works. Known archaeological finds in the rehabilitation area includes a Bog Body and other archaeological artefacts.

2.17.5 Aerial Imagery / LiDAR

Derrycashel Bog aerial images available prior to the commencement of the rehabilitation date from April 2020 and LiDAR was flown in September 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Derrycashel Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.18 Derrycolumb Bog

Derrycolumb Bog is located approximately 9.5km to the west of Ballymahon in County Longford. The area of the bog is 461 hectares. Industrial peat production commenced in the mid-1980s with production ceasing in 2019. Further information on the bog is available in the Derrycolumb Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation of Derrycolumb Bog commenced in May 2021 and was 94% complete at the end of June 2022.

2.18.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Derrycolumb bog. A total of 20 nests comprised of 2 deep wells and 20 Phreatic wells have been installed, 9 Phreatic wells have been instrumented with automated loggers, with a subset of the deep piezometers (1) instrumented with automated loggers. The location of these nests are shown on Drawing No. BNM-DR-22-12-32 in Appendix S0. A total of four monitoring visits have been carried out to date at Derrycolumb bog as outlined in Appendix S1 - Derrycolumb Bog - Hydrological Monitoring, with manual dipping completed in July 2021, February 2022, and logger dipping in August 2022. Monitoring will be ongoing at Derrycolumb bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix S1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1 sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data

indicates that water levels were notably higher across all monitoring wells in summer 2022 compared to summer 2021. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data gathered from well DCo_12_S demonstrates a significant change to the hydrological regime following rehabilitation. There is a rapid increase in water levels in September 2021 coinciding with the implementation of rehabilitation measures (DPT3), with water levels continuing to rise above ground level during winter 2021/22 and remaining above ground surface throughout summer 2022. This monitoring well is located within an area where DPT3 measures have been carried out, demonstrating that these measures have been very effective in this area. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

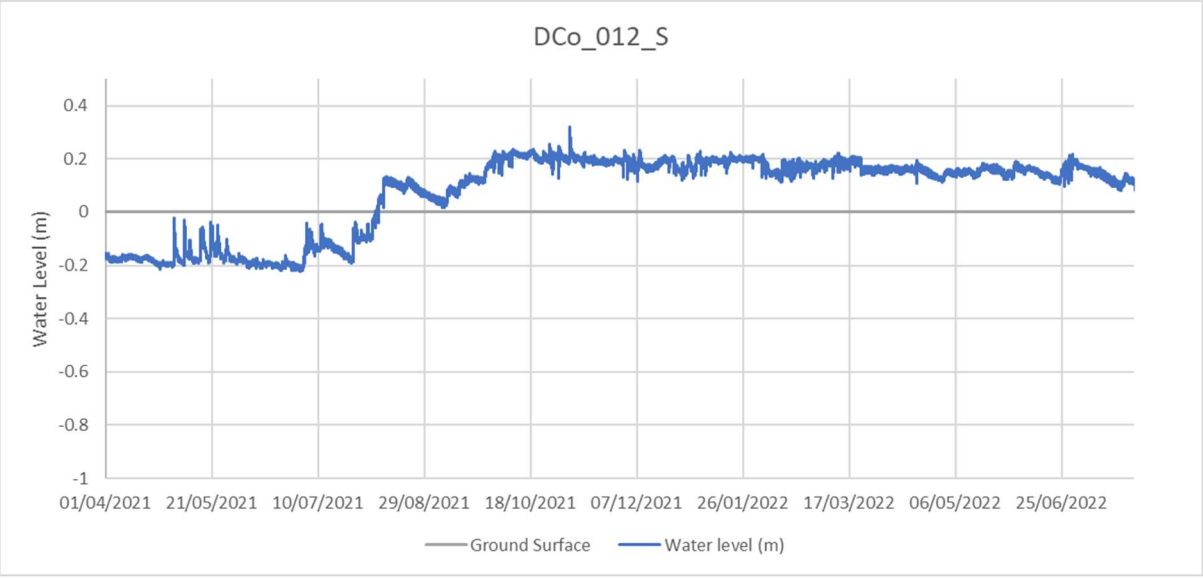

Figure 2.18.1: Hydrograph for monitoring well DCo_012s

2.18.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Derrycolumb Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Derrycolumb Bog can be divided into two separate lobes north and south of a dividing local road. The Bilberry River flows in an easterly direction along the northern boundary of the bog.

The majority of Derrycolumb Bog (approximately (approximately 80%) is classified as the community 'Bare peat (0-50% cover)' (BP). Pioneer cutaway vegetation is beginning to develop in bare peat areas across Derrycolumb Bog, forming mosaics with pioneering poor fen and Birch/Willow scrub. There are frequent patches of shallow surface water.

The following vegetation communities were recorded during the surveys carried out in 2021. Open habitats recorded forming mosaics with bare peat included 'Pioneer *Juncus effusus* community' (pJeff), 'Pioneer *Triglochin palustris* community' (pTrig), 'Pioneer *Eriophorum angustifolium* community (poor fen)' (pEang), '*Typha* community' (pTyp) and '*Phragmites australis* community' (pPhrag) with 'Open *Betula*-dominated community (B)' (oBir) beginning to develop in places. The ruderal habitat based '*Tussilago*-dominated community' (DisCF) was recorded frequently on the small gravel mounds of sub-soil in the eastern part of the bog.

In the northern section of the bog there are areas of more established vegetation pioneer open habitats and scrub dominated by 'Pioneer *Juncus effusus* community' (pJeff) and the grassland communities '*Anthoxanthum-Holcus-Equisetum* community' (gAn-H-Eq) and '*Molinia caerulea* dominated community' (gMol). 'Open *Betula*-dominated community' (oBir) forms pockets of scrub in these areas.

Closer to the northern boundary '*Betula-Salix* woodland' (BirWD) is beginning to develop with an understory of *Juncus effusus*. Small areas of remnant raised bog habitat remain along the margins of Derrycolumb Bog. Remnant raised bog around the south-eastern part of the bog includes a small area of active raised bog. The communities present in remnant raised bog include 'Dry *Calluna* community' (dHeath) and 'Open *Betula*-dominated community (B)' (oBir).

Derrycolumb Bog has a mosaic of different overlapping environmental characteristics influenced by residual peat depths, sub-soils and hydrology. Areas of deep residual peat in the south-eastern lobe of the bog have not yet developed significant ecological indicator species relating to acidic water chemistry at present, and these areas remain dominated by bare peat (black fen peat/red acidic peat). Some areas of Derrycolumb have ecological indicators (*Typha* community) of more alkaline ground-water or sub-soil influence developing in drains.

Rehabilitation was carried out at Derrycolumb in 2021. It is too soon for habitats at Derrycolumb Bog to reflect post rehabilitation change or succession. Approximately 80% of Derrycolumb remains as re-wetted bare peat.

Almost no new pioneering vegetation is present in the rehabilitation extent in these bare peat areas (see also Quadrat survey results, below). Some areas of the bog already have well established pioneer vegetation including poor fen, scrub and Birch woodland. The habitats already present will continue to develop post rehabilitation. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of peatland and wetland habitat development in the re-wetted parts of this site in the future.

Figure 2.18.2: Bare peat.

Figure 2.18.3: Pioneer open habitats

Figure 2.18.4: Remnant raised bog at Derrycolumb.

Figure 2.18.5: Closed Birch Woodland.

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Derrycolumb bog in June 2021 in accordance with agreed EDRRS Monitoring and Verification. Five quadrats were employed.

Constraints

No constraints were identified.

Results

Quadrats Q1, Q3, Q4 & Q5 were dominated by bare peat (91-100% cover). Quadrat Q2 was located in an area of pioneering open habitats transitioning to open *Betula pubescens* scrub. However, this area still contains by extensive bare peat. The pioneering vegetation in the area comprised mainly of *Juncus effuses* and *Molinia caerulea*. See Table 1 of Appendix S2 for detailed quadrat data.

Discussion

As with habitats the quadrats reflect the current baseline conditions pre-rehabilitation. Post-rehabilitation, further time is required before any vegetation colonisation or change is likely to be recorded.

Figure 2.18.6: Quadrat Q2

Figure 2.18.7: Quadrat Q4

Breeding Birds – Monitoring YR1

Methods

A single breeding wader visit was undertaken on May 14th, 2021. No CBS visits were undertaken in 2021. The survey was carried out under good conditions and covered the period 06:10am to 01:26pm.

Constraints

There were no constraints noted.

Results- Species Richness

A single pair of the BOCCI (Gilbert *et al.* 2021) Amber listed Ringed Plover *Charadrius hiaticula* was recorded. On this basis 1 pair is assumed to have attempted to breed onsite in 2022.

Results – Annual Relative Abundance

Two Ringed Plover were recorded.

Results – Habitat Associations

The recorded Ringed Plover were associating with was an open area of bare peat (pre-rehabilitation).

Results – Colonial Species

No colonial species were recorded.

Discussion

The occurrence on cutaway of Ringed Plover been previously described in unpublished reports such as Copland 2009, 2010 where it has been suggested that broken peat extraction infrastructure such as concrete pies, act as a surrogate for the pebbles which this species normally nests amongst to better conceal its eggs. Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this was supported by observations

at Derrycolumb in 2021. Survey effort was limited in 2021 and further monitoring will determine whether rehabilitation under the scheme alters the assemblage of breeding waders at this bog. No significant change in breeding bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Derrycolumb, but measures have consolidated conditions for wetland habitats to continue to develop to support breeding bird species using the site.

Winter Birds – Monitoring YR1

Method

Six no. counts were completed at approximately monthly intervals. The count period included the months September 2021 to February 2022 inclusive. All surveys covered the period 10:00 to 14:10 and were carried out in conditions with no rain and good visibility.

Constraints

Certain scheme related activities and separate activity connected to an under construction greenway were noted as potential sources of disturbance or visual intrusion during counts.

Results – Species Richness

A total of five water bird species were recorded across all surveys. One of these was a BOCCI (Gilbert *et al.* 2021) Red listed species namely Golden Plover. Two Amber listed species, Mallard and Whooper Swan were noted.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.18.1 and was highest for Golden Plover (n=50), followed by Mallard (n=4).Little Egret, Grey Heron and Whooper Swan were present on single counts only and in numbers <5 (range 1-2).

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Derrycolumb Bog. Golden Plover were noted day roosting on recently rehabilitated high fields near the public roadway which transects the bog.

Discussion

Overall species richness is considered very low during the period studied. A previous study (Delichon Ecology, 2021), which utilised 3 visits in the winter period of 2020/21 recorded a similar assemblage of species (Whooper Swan, Mallard, Grey Heron and Golden Plover) in similarly low numbers. On this basis the data presented here is considered indicative of baseline conditions.

In the context of an adjacent European Sites (such as Lough Ree SPA) which has wintering Whooper Swan, and '*Wetland and Waterbirds*' as special conservation interests a post rehabilitation Derrycolumb may contribute to further habitat for SCI species, act as a winter refugium for water birds of conservation concern and support the conservation objectives for these European Sites, although distance may be a limiting factor. In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds at this any other sites subject to rewetting under the current EDRRS Scheme.

No significant change in wintering bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Derrycashel, but measures have consolidated conditions for wetland habitats to continue to develop to support wintering bird species using the site.

Table 2.18.1: Winter 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Max
MA Mallard *Anas platyrhynchos*	Amber	0	0	4	0	0	0	1	4
ET Little Egret *Egretta garzetta*	Green	0	0	1	0	0	0	0	1
WS Whooper Swan *Cygnus cygnus*	Amber	0	0	2	0	0	0	0	2
H. Grey Heron *Ardea cinerea*	Green	0	0	1	0	0	0	0	1
GP Golden Plover *Pluvialis apricaria*	Red	0	50	0	0	0	0	8	50

Breeding Birds – Monitoring YR2

Methods

CBS surveys comprised 2 no. transects were visited 3 times in the period April to July inclusive. Breeding waders' surveys were undertaken on four dates between April and July. CBS counts covered the period 08:45am – 10:15am across all visits. Breeding wader surveys generally covered the same period. See the Figure in Appendix S2 titled '*Derrycolumb Bog Ecology Transects'* for transect route location.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields or headlands associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to transects but which are not subject to rehabilitation. Where relevant this is further addressed in the Discussion section. Due to unforeseen circumstances one CBS count in June was omitted, however data from two counts in the typical CBS period plus an additional count in July are available.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am-11:00am). CBS recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. Data are considered acceptable for analysis in the current instance based on timings presented above. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 36 no. species were recorded, see Table 2.18.2. This included five BOCCI (Gilbert *et al.* 2021) Red listed species, Black headed gull, Grey Wagtail, Lapwing, Meadow pipit, and Snipe along with eight BOCCI Amber listed species namely Goldcrest, Lesser Black backed gull, Mallard, Ringed plover, Skylark, Swallow, Sand Martin and Willow Warbler. Remaining species (n=24) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

A bespoke breeding waders survey was undertaken in 2022, data on breeding pairs is herein presented in line with an interpretation following the O'Brien and Smith (1992) method for censusing lowland breeding wader populations. On this basis 0-1 pairs of Lapwing, 1 pair of Ringed Plover and 2 pairs of Snipe bred onsite in 2022.

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species across visit #1, #2, or #3 or within the period April to June inclusive, see Table 2.18.2. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 10 individuals were recorded for six species, Wren (n=18), Redpoll (n=15), Robin (n=15), Blackbird (n=12) and Chaffinch (n=11). All remaining species never exceeded a maximum count of 7.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Seventeen species considered associated with NON-OPEN habitats were recorded and eighteen species associated with OPEN habitats were recorded see Table 2.18.2. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were observed.

Discussion

The occurrence on cutaway, cutover or raised bog of many of the species recorded in this study have been previously described in literature such as Wilson 1990, Bracken *et al.* 2008 and in unpublished reports such as Copland 2010.

All five Red listed species recorded are associated with open habitats targeted for rehabilitation in the form of rewetting and would be expected to gain from measures intended to effectively create wetlands or stabilised areas of drier vegetating cutaway. Black-headed Gull, Lapwing and Snipe have been shown to associate with cutaway wetlands in the past (Copland 2009), and it is notable that

despite there being only a single visit in 2021 for comparison, all three species may have colonised Derrycolumb post rehabilitation.

Breeding waders comprised Snipe (2 pairs), Lapwing (0-1 pairs) and Ringed Plover (1 pair). In 2021, only Ringed Plover was recorded at Derrycolumb although we note that breeding wader estimates are based on 1 visit only. Some species recorded utilising Derrycolumb such as Lesser Black-backed Gull, along with Corvids and Raptor species such as Buzzard have the potential to predate breeding wader nests and young, and future management could be required to optimise breeding wader success.

Regarding habitat associations 52% of species recorded are more associated with open habitats. Many of these species breed on or frequently visit open areas of cutaway to forage. Open habitat species comprise a higher proportion of Red and Amber listed species (11 no. in total). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case. It must be noted that species more associated with non-open habitats dominated abundance in 2022, however this may reflect transect location which inevitably samples adjacent hedgerows/woodland. Over time as birds utilising cutaway increases this proportion may change.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutover bogs such as Derrycolumb.

Table 2.18.2: 2022 – Monitoring YR2 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	12
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	4
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	1
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	2
BZ Buzzard *Buteo buteo*	Green	OPEN	1
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	11
CT Coal tit *Periparus ater*	Green	NON-OPEN	1
CK Cuckoo *Cuculus canorus*	Green	OPEN	1
D. Dunnock *Prunella modularis*	Green	NON-OPEN	0
GC Goldcrest *Regulus regulus*	Amber	NON-OPEN	2
GL Grey Wagtail *Motacilla cinerea*	Red	OPEN	3
GO Goldfinch *Carduelis carduelis*	Green	OPEN	2
H. Grey Heron *Ardea cinerea*	Green	OPEN	1
HC Hooded Crow *Corvus cornix*	Green	OPEN	6
JD Jackdaw *Corvus monedula*	Green	NON-OPEN	2
J. Jay *Garrulus glandarius*	Green	NON-OPEN	1
L. Lapwing *Vanellus vanellus*	Red	OPEN	1
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	0
LB Lesser Black-backed Gull *Larus fuscus*	Amber	OPEN	0
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	15
MA Mallard *Anas platyrhynchos*	Amber	OPEN	1

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	6
R. Robin *Erithacus rubecula*	Green	NON-OPEN	15
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	2
RP Ringed Plover *Charadrius hiaticula*	Amber	OPEN	0
S. Skylark *Alauda arvensis*	Amber	OPEN	4
SL Swallow *Hirundo rustica*	Amber	OPEN	2
SM Sand Martin *Riparia riparia*	Amber	OPEN	3
SN Snipe *Gallinago gallinago*	Red	OPEN	2
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	4
SH Sparrowhawk *Accipiter nisus*	Green	NON-OPEN	0
SW Sedge Warbler *Acrocephalus schoenobaenus*	Green	OPEN	1
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	7
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	18
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	12

Pollinators- YR1

Methods

Two counts were carried out, one each in June and August of 2021. All surveys were completed between 10:00am and 04:00pm, when the temperature was at least 13°C and during good weather conditions. Transect length was 2km. See the Figure in Appendix S2 titled '*Derrycolumb Bog Ecology Transects'* for transect route location.

Constraints

Wind occasionally reached higher than ideal speeds but this may reflect the open nature of the cutaway and is relatively unavoidable.

Results- Species Richness

A total of ten species of butterfly were recorded namely Common Blue, Green-veined White, Large White, Meadow Brown, Small copper, Small tortoiseshell Peacock and Speckled wood. In addition to butterflies, White Tailed Bumblebee (n = 14), Emperor dragonfly (n = 5), Four Spotted Chaser (n=3), Brown Hawker (n = 1) and Common Darter (n = 8) were recorded during the surveys.

Results – Abundance

Small tortoiseshell occurred in the highest abundance (19 overall), with this maximum abundance recorded during the survey in August. This species was not recorded during the July Survey. Meadow Brown was recorded in the highest abundance during the July Survey (8 individuals). The highest abundance overall per month was recorded in August.

Results – Habitat Associations

The section of the transect veering west follows the route of the former decommissioned railway line and this area has some established vegetation either side. The section of the transect in the western lobe of the bog, generally follows the headland and a high field, both dominated with bare peat.

Discussion

The baseline scenario for Derrycolumb in 2021 reflected a suite of pre-rehabilitation habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators.

Pollinators- YR2

Methods

The transect at Derrycolumb is 2km in length. All surveys were completed between 10:00 and 16:00hrs, when the temperature was at least 13°C and during good weather conditions. Four counts were carried out, one each in May, June, July and August of 2022. See the Figure in Appendix S2 titled '*Derrycolumb Bog Ecology Transects'* for transect route location.

Constraints

Wind occasionally reached higher than ideal speeds but this may reflect the open nature of the cutaway and is relatively unavoidable.

Results – Species Richness

A total of ten species of butterfly were recorded namely Common Blue, Green-veined White, Large White, Meadow Brown, Orange Tip, Ringlet, Small Copper, Small Heath, Small Tortoiseshell and Small White. In addition to butterflies, White Tailed Bumblebee (n = 2), Emerald damselfly (n = 1)
Four Spotted Chaser (n=1) were recorded during the surveys.

Results – Abundance

Meadow Brown occurred in the highest abundance (26 overall), with this maximum abundance recorded from the July survey. This species was not recorded during any of the other monthly surveys. Ringlet and small tortoiseshell were also recorded in high abundance in the later months of the summer. The highest abundance overall per month was recorded in July.

Results – Habitat Associations

The south-eastern end of the transect follows the route of the former decommissioned railway line and this area has some established vegetation either side. A higher proportion of pollinators were encountered along this section of the transect.

In general, little or no pollinator activity was clearly associated with bare peat or recently rehabilitated bare peat areas. Species recorded on bare peat sections of the transect were primarily traversing the transect to nearby grassy verges, as insufficient vegetation is present to attract feeding pollinators.

Discussion

The importance of regenerating cutaway for Irish butterflies has been described for certain sites such as Lullymore, Co. Kildare, (Harding 2008). However, the baseline scenario for Derrycolumb still reflects habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators.

Table 2.18.3: 2022 – Monitoring YR2 Pollinator Survey Results

Species	May	June	July	August	Total
Peacock *Aglais io*	0	0	1	0	1
Total	0	0	1	0	1

2.18.3 Surface Water Quality

Derrycolumb bog has seven treated surface water outlets to the Ledwithstown IE_SH_26L840850 and Drumnee IE_SH_26D080850 rivers and eventually the Shannon Upper IE_SH_25SO21660. Three of these outlets are monitored as part of EDRRS (SW88A, 90 & 91) and the location of these outlets are shown on Drawing No. BNM-DR-22-12-32 in Appendix S0.

Analysis of over 5 years of the IPC licence environmental monitoring programme, indicates that recommended parameters such as Suspended solids had an average of 6.95 mg/l with Ammonia averaging 0.526 mg/l, as per results below.

Table 2.18.4: Derrycolumb Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
Derrycolumb	SW-88	Q4 19	07/11/2019	7.6	9	260	1.7	0.05	45	249
Derrycolumb	SW-88A	Q4 19	07/11/2019	7.7	12	185	0.163	0.05	43	310
Derrycolumb	SW-89	Q4 19	07/11/2019	7	5	85	0.409	0.05	37	216
Derrycolumb	SW-90	Q4 19	07/11/2019	7.9	7	264	0.255	0.05	53	257
Derrycolumb	SW-91	Q4 19	07/11/2019	7.8	7	309	0.107	0.05	65	251
Derrycolumb	SW91-A	Q4 19	07/11/2019	7.3	6	213	0.094	0.05	82	396
Derrycolumb	SW-92	Q4 19	13/11/2019	7.8	3	360	0.107	0.05	72	232
Derrycolumb	SW-93	Q4 19	13/11/2019	7.4	2	233	0.112	0.05	85	339
Derrycolumb	SW-93A	Q4 19	13/11/2019	7.40	2	257	0.315	0.05	51	128
Derrycolumb	SW-88	Q2 17	29/05/2017	7.9	6	632	0.2	0.05	40	114
Derrycolumb	SW-88A	Q2 17	29/05/2017	7.7	5	320	0.37	0.05	39	124
Derrycolumb	SW-89	Q2 17	29/05/2017	7.7	5	374	0.17	0.05	50	144
Derrycolumb	SW-90	Q2 17	31/05/2017	7.7	6	280	0.46	0.05	42	110
Derrycolumb	SW-91	Q2 17	31/05/2017	7.8	5	408	0.26	0.05	42	116
Derrycolumb	SW91-A	Q2 17	31/05/2017	7.9	7	368	0.32	0.05	57	108
Derrycolumb	SW-92	Q2 17	31/05/2017	7.5	5	219	3.9	0.05	48	144
Derrycolumb	SW-93	Q2 17	31/05/2017	7.8	6	628	0.53	0.05	51	111
Derrycolumb	SW-93A	Q2 17	31/05/2017	7.6	10	308	0.05	0.05	42	125
Derrycolumb	SW-91	Q2 16	09/06/2016	7.3	19	302	0.85	0.33	112	267
Derrycolumb	SW-92	Q3 16	12/09/2016	7.2	12	176	0.16	0.12	89	225

Monthly EDRRS baseline monitoring commenced in August 2020, which gave 25 sampling events for this report, up to August 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 4.7mg/l from outlet SW88A, 3mg/l from outlet SW90 and 2.9mg/l from outlet SW91.

Similarly, Ammonia had an average of 0.405 mg/l, which is less than when the bog was in active production and trended in a slight reducing trajectory. Derrycolumb rehabilitation commenced in May 2021 and since then overall trends remained neutral with a slightly increasing concentration in Suspended Solids during the period with a clear but lagging relationship between rainfall and concentration of run-off at these locations. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.6.

Surface water monitoring for the period and associate graphs are in Appendix S3.

2.18.4 Archaeology

Derrycolumb Bog was included in the National Monuments Service archaeological monitoring programme carried out by Archaeological Management Solutions (AMS).

Derrycolumb Bog, Co. Longford was visited on eighteen occasions during the rehabilitation works. The primary purpose was to monitor the ongoing rehabilitation works including cell formation and drain blocking and to inspect the peat fields and drain sections across the bog for any possible archaeological features. Conditions under foot varied from dry and stable from August to October but gradually became wetter and softer from November to February resulting in raised water levels in many of the cells and drains. Drainage pipes and or sheet piles were subsequently placed in the berms of existing cells throughout the bog to ensure a water level beneficial to sphagnum moss growth.

Four sites on Derrycolumb Bog were identified during monitoring of rehabilitation works. These included a brushwood and roundwood platform (LF-Derrycolumb-01), a hurdle and possible brushwood trackway (LF-Derrycolumb-02), the location of a worked wooden post (LF-Derrycolumb-03) and a wooden platform (LF-Derrycolumb-04).

No archaeological finds were discovered and reported during the rehabilitation measures. During the initial Archaeological Impact Assessment desk study, there was only one known surviving archaeological monument in Derrycolumb Bog RMP LF022-06301-, with the location avoided by the regeneration works with a 20m buffer.

2.18.5 Aerial Imagery / LiDAR

Derrycolumb Bog aerial images available prior to the commencement of the rehabilitation date from May 2020 and LiDAR was flown in September 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Derrycolumb Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

2.19 Edera Bog

Edera Bog is located approximately 4.5km to the west of Ballymahon in Co. Longford. The bog is located adjacent to Lough Ree and several designated conservation sites and the Bilberry River flows through the site. The area of the bog is 282 hectares. Edera Bog has been in peat production since 2003, with all commercial peat extraction ceasing on site in 2018. Further information on the bog is available in the Edera Bog Cutaway Bog Decommissioning and Rehabilitation Plan 2021. Rehabilitation commenced on Edera Bog in May 2021 and was 95% complete at the end of June 2022.

2.19.1 Hydrological Monitoring

Hydrological monitoring is ongoing at Edera bog. A total of 12 nests comprised of 9 deep wells and 12 Phreatic wells have been installed, 5 Phreatic wells have been instrumented with automated loggers, with a subset of the deep piezometers (1) instrumented with automated loggers. The location of these nests are shown on Drawing No. BNM-DR-22-04-32 in Appendix T0. A total of four monitoring visits have been carried out to date at Edera bog as outlined in Appendix T1 - Edera Bog - Hydrological Monitoring, with manual dipping completed in July 2021, February 2022, and logger dipping in July 2022.Monitoring will be ongoing at Edera bog over the next three years (2023, 2024, 2025).

A summary of manual readings is provided in Appendix T1. Limited water table measurements were carried out in Summer 2022 as EDRRS Year 1sites were not originally scheduled for monitoring, with only wells containing loggers dipped in Summer 2022. Further information will become available as monitoring is ongoing throughout future years. An initial review of the manual water level data indicates that water levels were higher at most monitoring wells in summer 2022 compared to summer 2021, although there are some exceptions. However, this is based on a limited set of measurements, and it is important to note that a single manual reading at a point in time does not consider the difference in weather conditions leading up to the monitoring taking place. The logger data gathered from well ED_006_S demonstrates a significant change to the hydrological regime following implementation of rehabilitation measures (DPT4). There is a rapid increase in water levels in October 2021 coinciding with the implementation of rehabilitation measures, with water levels rising above ground surface during winter 2021/22 before dropping during summer 2022. However, despite water levels dropping to 26cm below ground level, this remains significantly higher than during summer 2021 when water levels of 82cm below ground surface were recorded. More thorough analysis should be carried out by reviewing details of the logger data which will become available shortly through the project hydrological dashboard. Furthermore, readings are only an indication of results and should be reviewed in subsequent years as water levels are anticipated to take a number of years to stabilise.

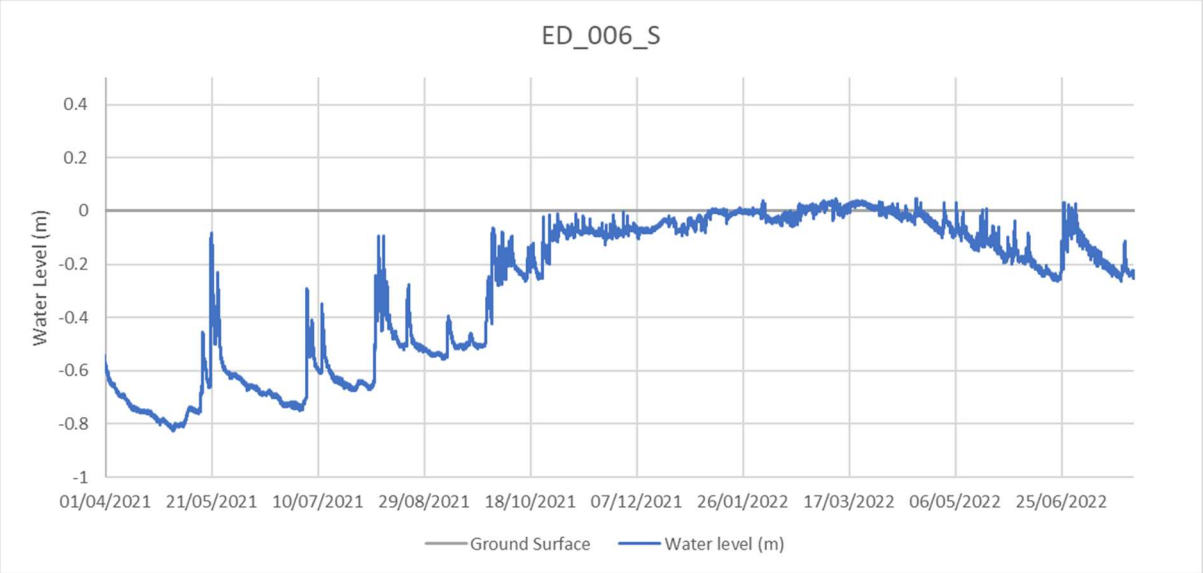

Figure 2.19.1: Hydrograph for monitoring well ED_006s

2.19.2 Biodiversity

Habitats – Monitoring YR1

Method

As part of EDRRS Monitoring and Verification, Bord na Móna carried out a baseline ecological survey of habitats at Edera Bog during summer 2021 and 2022.

Constraints

No constraints were identified, and all parts of the bog were accessible during the survey.

Results

Edera Bog can be divided into two separate lobes one smaller northern lobe and a larger southern lobe, south of the Bilberry River, which divides the two. The Bilberry river flows west to east through the site and is surrounded on both sides by relatively extensive areas of wet grassland that are subject to flooding.

The majority of Edera Bog (approximately 90%) within the former peat extraction area is re-wetted bare peat ('Bare peat (0-50% cover)' or BP). There is scattered colonisation of pioneer species including *Calluna vulgaris* and *Molinia caeruleae.* At present, vegetation cover is still too low to classify as pioneer communities yet. There are frequent patches of scattered shallow water present.

Edera bog is underlain with both marl and gravel. Some areas of Edera Bog are cutaway exposing the shell marl substrate, particularly in the north-western corner of the southern lobe. These areas are generally wet and subject to seasonal inundation. Pioneer poor fen communities are beginning to develop in these areas, forming mosaics with bare peat, including '*Phragmites australis* community' (pPhrag), 'Pioneer *Juncus effusus* community' (pJeff), '*Carex rostrata* community '(pRos) and 'Pioneer *Triglochin palustris* community' (pTrig). The ruderal community '*Tussilago*-dominated community' (DisCF) occurs frequently on the exposed marl also.

A significant area of scrub (WS1), raised bog (PB4) and wet grassland (GS4) is located in the west of the site outside of the former production fields. This area is located next to Lough Ree and has never been in industrial peat production; however, some domestic turf cutting has been carried out in this area. The remnant section of raised bog does not appear to contain deep peat and is located in the transitional zone between what was the former intact raised bog (Edera) and the wet grassland that borders Lough Ree. Purple Moorgrass is dominant across much of this section of raised bog. This area, immediately adjacent to Lough Ree, can flood in winter of lake water levels are high.

A small area of remnant raised bog (PB1) and cutaway bog (PB4) is also located along the north-eastern boundary of the site. This area is used extensively for domestic turf production under licence to Bord na Móna. The most common habitats found around the margins of Edera Bog include Marginal raised bog (PB1), Cutover bog (PB4), Scrub (WS1), Dry heather dominated vegetation, Birch woodland (WN7), Wet grassland (GS4) (privately managed farmland) and Improved agricultural grassland (GA1).

There are ecological indicators (Bulrush, Bottle Sedge, Milfoil) of ground-water influence or alkaline sub-soil influence on water-chemistry in the cutaway zone located adjacent to the Bilberry River. This indicates less acidic water chemistry influence on this zone. This zone is also prone to seasonal winter inundation via the Bilberry River and this reflects seasonal water fluctuations in Lough Ree. In areas of residual deep bare peat groundwater is unlikely to have a significant influence on the vegetation and water chemistry is likely to be influenced by rainwater and by the more acidic residual peat.

Rehabilitation has been carried out at Edera Bog in 2021. It is too soon for habitats at Edera to reflect post rehabilitation change or vegetation/habitat succession. Approximately 90% of the former peat extraction area of Edera remains as re-wetted bare peat.

Only small areas of the former peat extraction area subject to rehabilitation have begun to recolonise with pioneering vegetation (see also Quadrat survey results, below). These habitats are developing best on cutaway areas with an exposed marl substrate that are subject to seasonal inundation. The habitats already present are expected to continue to develop post rehabilitation.

Some final manipulation of bunded cells by the insertion of plastic sheet piles and/or overflow pipes is still to be carried out so further time is needed for optimum water levels to potentially develop at the surface of these areas.

In conclusion the habitats recorded in 2021/2022 largely reflect the baseline status of a recently transformed peat extraction site. Re-wetting will help consolidate changes in environmental condition that continue to encourage the development of peatland and wetland habitat development in the re-wetted parts of this site in the future.

Figure 2.19.2: Bare peat (PB4) in the former production area

Figure 2.19.3: Pioneer poor fen

Figure 2.19.4: Pioneer *Eriophorum angustifolium* vegetation

Figure 2.19.5: The Bilberry River divides the northern and southern lobe

Vegetation Quadrats – Monitoring YR1

Method

Quadrat monitoring was carried out at Edera bog during summer of 2021 in accordance with agreed EDRRS Monitoring and Verification. Five quadrats were employed.

Constraints

No constraints were identified.

Results

Quadrats Q1, Q2 & Q5 were dominated by bare peat (91-100% cover). Quadrats Q3 & Q4 were located in an area of pioneering open habitats that was subject to seasonal inundation and was therefore establishing as a wetland. However, these areas were still dominated by extensive areas of bare peat. The pioneering vegetation in the area in which these two quadrats were located comprised mainly of *Triglochin palustris or Carex rostrata, with Tussilago farfara, Hippuris vulgaris, Molinia caerulea and Potentilla erecta also occurring.* Some *Betula pubescens* was also beginning to establish in the area.

This area was also located in relatively shallow peat. See Table 1 of Appendix T2 for detailed quadrat data.

Discussion

As with habitats the quadrats reflect the current baseline conditions pre-rehabilitation. Post-rehabilitation, further time is required before any vegetation colonisation or change is likely to be recorded.

Winter Birds – Monitoring YR1

Method

Six monthly counts were completed in line with the methodology as described in Section 1.2 The count period included the months September 2021 to February 2022 inclusive.

Constraints

Some parts of Edera post rehabilitation, particular headlands, were difficult to access due to unstable peat, but otherwise no constraints were noted.

Results – Species Richness

A total of seven water bird species were recorded across all surveys. One of these was a BOCCI (Gilbert *et al.* 2021) Red listed species namely Common Snipe. Four Amber listed species were recorded namely Mallard, Mute Swan, Whooper Swan and Kingfisher.

Results – Abundance

Average (mean) abundance across the winter period is presented in Table 2.19.1 and was highest for Common Snipe (n=7), followed by Whooper Swan (n=6). Common Snipe was present on five of six counts whilst Whooper Swan was present or recorded on four of six counts. Remaining water bird species were recorded in low numbers (range 1-2).

Results – Habitat Associations

Most birds across all counts were found to associate with habitats present at Edera Bog. One observation of Whooper Swan in November was a flyover record but otherwise this species was recorded associating with habitats on site. Common Snipe were recorded from pioneering cutaway habitats and bog margins and observations of Kingfishers were birds associating with the River Bilberry whose corridor traverses the bog.

Discussion

Overall species richness is considered low during the period studied given the proximity of Edera to Lough Ree. A previous study (JOD, 2021), which utilised 3 visits in the winter period of 2020/21 recorded a similar assemblage of species but additionally noted the presence of Coot, Little Grebe, Grey Heron and Water Rail. Interannual variation in winter water levels at Lough Ree and consequently the corridor of the Bilberry River may account for differences between years. In 2020/21 Common Snipe also had the highest abundance and were recorded in numbers of 10 or more per visit (range = 10-29). This species is difficult to count accurately due to its cryptic camouflage and fondness for resting in dense vegetation and total counts of all but the smallest wetland sites are generally underestimates (Smiddy *et al.* 2022), this is also likely the case at Edera.

In the context of an adjacent European Sites (Lough Ree SPA) which has wintering Whooper Swan, and '*Wetland and Waterbirds'* as qualifying interests a post rehabilitation Edera may contribute to further habitat for SCI species, act as a winter refugium for water birds of conservation concern and support the conservation objectives for these European Sites.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of wintering birds at both Edera and other bogs in the EDRRS scheme. No significant change in wintering bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Edera, but measures have consolidated conditions for wetland habitats to continue to develop to support wintering bird species using the site.

Table 2.19.1: 2021/2 – Monitoring YR1 IWeBS Survey Results

Species	BOCCI 2020 - 2026 STATUS	SEP	OCT	NOV	DEC	JAN	FEB	Mean	Max
MA Mallard *Anas platyrhynchos*	Amber	1	2	1	0	0	0	1	2
MS Mute Swan *Cygnus olor*	Amber	1	0	2	1	1	0	1	2
SN Common Snipe *Gallinago gallinago*	Red	0	2	4	7	7	1	4	7
WS Whooper Swan *Cygnus cygnus*	Amber	0	6	1	4	4	0	3	6
KF Kingfisher *Alcedo atthis*	Amber	1	0	0	0	0	0	0	1
MH Moorhen *Gallinula chloropus*	Green	0	1	0	0	0	0	0	1
JS Jack Snipe *Lymnocryptes minimus*	Green	0	0	1	0	0	0	0	1

Breeding Birds – Monitoring YR1

Methods

CBS surveys comprised 3 no. (1km in length) transects were visited four times in the period April to July inclusive of 2022. Breeding waders' surveys were also undertaken on the same dates. See the figure titled '*Edera Bog Ecology Transects'* in Appendix T2 for transect route location.

Constraints

Health and Safety imperatives required the transect routes to be safe for human access and therefore the locations selected are in line with high fields or headlands associated with former peat extraction. Due to their location sampling results may include species which utilise the areas adjacent to transects but which are not subject to rehabilitation. Where relevant this is further addressed in the Discussion section.

The British Trust for Ornithology (www.bto.org) advises that the ideal time of day to count birds (BBS) in the breeding season is roughly one hour after sunrise until mid-morning (10:00am-11:00am). CBS

recommended timings are early morning, no later than 9:00am 'ideally' but allowance is made to extend this period for sites which require longer travel times or where access is difficult. The timing of the visit in June exceeded the CBS recommended period for surveying in June but was complete by 11:20am and data are considered acceptable for analysis. Any bias on a per species level is discussed further under Discussion, where relevant.

Results- Species Richness

Species richness is presented as the total number of species recorded across both transects. For completeness, any additional species recorded off transect but considered to be associating with habitats on site on any single visit are included where relevant.

A total of 49 no. species were recorded, see Table 2.19.2. This included five BOCCI (Gilbert *et al.* 2021) Red listed species Black headed gull, Cormorant, Lapwing, Meadow pipit, Snipe and Swift along with 12 no. BOCCI Amber listed species namely Goldcrest, Lesser Black backed gull, Linnet, Mallard, Mute swan, Ringed plover, Skylark, Swallow, Sand Martin, Common Tern and Willow warbler. Remaining species (n=34) were all Green listed apart from Pheasant which is not assigned a BOCCI status.

A bespoke breeding waders survey was undertaken in 2022, data on breeding pairs is herein presented in line with an interpretation following the O'Brien and Smith (1992) method for censusing lowland breeding wader populations. On this basis 2 pairs of Lapwing, 2 pairs of Ringed Plover and 7 pairs of Snipe bred onsite in 2022. Ringed Plover chicks were observed in May and June visits (n=1 per visit).

Results – Annual Relative Abundance

Annual relative abundance (ARA) is presented as the maximum count per species across visit #1, #2, or #3 or within the period April to June inclusive, see Table 2.19.2. This allows for future comparison with CBS trends which takes the same approach to index species.

Maximum counts of greater than 20 individuals were recorded for three species, Lesser Black backed Gull (n=40) , Wren (n=34) and Meadow pipit (n=33). Maximum counts of between 10 and 20 individuals were noted for 5 species, Blackbird, Sand Martin, Blackcap, Hooded Crow and Skylark. All remaining species never exceeded a maximum count of 9.

Results – Habitat Associations

Habitat associations are broadly grouped in line with other published interpretations and fall into two categories, those species of OPEN or NON-OPEN habitats. Associations are interpreted following Nairn & O'Halloran 2012. The category OPEN has been applied to those species most strongly associated with the more open areas of cutover bog such as bare peat, pioneering vegetation, mosaics of open water and fen (wetlands) and intact high bog. Species generally associated with scrub and woodland are assigned to the NON-OPEN category unless literature suggests they also commonly breed in more open habitats such as found on cutaway bogs. Twenty two species considered associated with NON-OPEN habitats were recorded and twenty six species associated with OPEN habitats were recorded see Table 2.19.2. One species associates with both OPEN and NON-OPEN categories (Wren).

Results – Colonial Species

No colonies were observed.

Discussion

Of the five Red listed species recorded, three (Black-headed Gull, Lapwing, and Snipe) are associated with open habitats targeted for rehabilitation in the form of rewetting and would be expected to gain from measures intended to effectively create wetlands. Meadow pipit would be associated with drier habitats or those areas targeted for fertiliser application such as high fields, whilst Swift will forage over open water (Cramp *et al.* 1985) and at low altitude over raised bog in certain conditions. Twelve Amber listed species were recorded of which one, Lesser Black-backed Gull had the highest abundance overall (peak of 40); this gull was recorded on three of four visits and in all instances was utilising a constructed cell in the east of Edera for roosting and loafing. In the context of proximity to a European Site (Lough Ree SPA) where Lesser Black backed Gull are known to be breeding then a rehabilitated Edera Bog may serve to support the conservation status of this species. Overall, however the total number of species either Red or Amber listed was 17 suggesting the importance of Edera for species of conservation concern in one form or other, either foraging or breeding or for use as a refugium.

Breeding waders were dominated by Snipe (7 pairs). Two pairs of Lapwing bred onsite. Ringed Plover successfully fledged young within a constructed wetland. We note that some species recorded utilising Edera such as Lesser Black-backed Gull, along with Corvids and Raptor species such as Buzzard have the potential to predate breeding wader nests and young.

Regarding habitat associations 55% of species recorded are more associated with open habitats. Many of these species breed on or frequently visit open areas of cutaway to forage. Open habitat species comprise a higher proportion of Red and Amber listed species (15 no. in total). Openness of habitat has previously been suggested as an important habitat feature benefitting species of conservation concern (Copland 2009), and this still seems the case.

In conclusion the data presented here forms a baseline for further interpretation of the effects of rehabilitation to assemblages of breeding birds utilising cutover bogs and establishes the potential importance of Edera post rehabilitation in respect of breeding birds of conservation concern, notably wading species, and gulls. No significant change in breeding bird species richness and abundance can be attributed to the wetland rehabilitation so far in the re-wetted section at Edera, but measures have consolidated conditions for wetland habitats to continue to develop to support breeding bird species using the site.

Table 2.19.2: 2022 – Monitoring YR1 Countryside Bird Survey Results

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
B. Blackbird *Turdus merula*	Green	NON-OPEN	16
BC Blackcap *Sylvia atricapilla*	Green	NON-OPEN	11
BF Bullfinch *Pyrrhula pyrrhula*	Green	NON-OPEN	1
BH Black-headed Gull *Chroicocephalus ridibundus*	Red	OPEN	4
BT Blue Tit *Cyanistes caeruleus*	Green	NON-OPEN	1
BZ Buzzard *Buteo buteo*	Green	OPEN	1
CA Cormorant *Phalacrocorax carbo*	Amber	OPEN	2
CC Chiffchaff *Phylloscopus collybita*	Green	NON-OPEN	5
CH Chaffinch *Fringilla coelebs*	Green	NON-OPEN	8
CK Cuckoo *Cuculus canorus*	Green	OPEN	7

SPECIES	BOCCI 2020 - 2026 STATUS	HABITAT ASSOCIATION	ARA
CN Common Tern *Sterna hirundo*	Amber	OPEN	1
CT Coal tit *Periparus ater*	Green	NON-OPEN	1
D. Dunnock *Prunella modularis*	Green	NON-OPEN	1
ET Little Egret *Egretta garzetta*	Green	OPEN	1
GC Goldcrest *Regulus regulus*	Amber	NON-OPEN	3
GO Goldfinch *Carduelis carduelis*	Green	OPEN	4
GT Great Tit *Parus major*	Green	NON-OPEN	3
H. Grey Heron *Ardea cinerea*	Green	OPEN	1
HC Hooded Crow *Corvus cornix*	Green	OPEN	10
J. Jay *Garrulus glandarius*	Green	NON-OPEN	3
JD Jackdaw *Corvus monedula*	Green	NON-OPEN	3
L. Lapwing *Vanellus vanellus*	Red	OPEN	4
LB Lesser Black-backed Gull *Larus* fuscus	Amber	OPEN	40
LI Linnet *Carduelis cannabina*	Amber	OPEN	5
LR Redpoll *Acanthis cabaret*	Green	NON-OPEN	7
LT Long-tailed Tit *Aegithalos caudatus*	Green	NON-OPEN	1
M. Mistle thrush *Turdus viscivorus*	Green	NON-OPEN	2
MA Mallard *Anas platyrhynchos*	Amber	OPEN	6
MH Moorhen *Gallinula chloropus*	Green	OPEN	1
MP Meadow Pipit *Anthus pratensis*	Red	OPEN	33
MS Mute Swan *Cygnus olor*	Amber	OPEN	1
PH Pheasant *Phasianus colchicus*	N/A	NON-OPEN	5
PW Pied Wagtail *Motacilla alba*	Green	OPEN	6
R. Robin *Erithacus rubecula*	Green	NON-OPEN	8
RB Reed Bunting *Emberiza schoeniclus*	Green	OPEN	4
RN Raven *Corvus corax*	Green	OPEN	5
RO Rook *Corvus frugilegus*	Green	NON-OPEN	7
RP Ringed Plover *Charadrius hiaticula*	Amber	OPEN	5
S. Skylark *Alauda arvensis*	Amber	OPEN	9
SC Stonechat *Saxicola rubicola*	Green	OPEN	1
SI Swift *Apus apus*	Red	OPEN	1
SL Swallow *Hirundo rustica*	Amber	OPEN	4
SM Sand Martin *Riparia riparia*	Amber	OPEN	16
SN Snipe *Gallinago gallinago*	Red	OPEN	5
ST Song Thrush *Turdus philomelos*	Green	NON-OPEN	7
WH Whitethroat *Sylvia communis*	Green	NON-OPEN	4
WP Woodpigeon *Columba palumbus*	Green	NON-OPEN	10
WR Wren *Troglodytes troglodytes*	Green	OPEN/NON-OPEN	34
WW Willow Warbler *Phylloscopus trochilus*	Amber	NON-OPEN	22

Pollinators YR1

Methods

All surveys were completed between 10:40am and 01:00pm, during good weather conditions. Four visits spanning May 2022 to August 2022 inclusive were made and on each occasion the 1km transect was walked from south to north. See the figure titled '*Edera Bog Ecology Transects'* in Appendix T2 for transect route location.

Constraints

The majority of the surveys were carried out when the temperature was at least 13°C, with the exception of the June and July surveys when the temperatures were 11°C and 12.5°C respectively. Weather conditions were optimal during all the other surveys.

Results- Species Richness

Species richness was very low, with only a single butterfly recorded, during only one of the surveys. This record was of a peacock butterfly recorded during the July survey. Records for incidental species were also low, with only the moth species *Agriphila selasella* (Pale-streak Grass-veneer) recorded during the July survey. Bombus sp. (n = 12) and Honeybee (n = 2) were recorded during the August survey.

Results – Abundance

Species abundance was very low. Peacock butterfly was the only species recorded during the surveys with a single individual recorded during the July survey. No other butterfly species were recorded during any of the other surveys.

Results – Habitat Associations

Overall species richness and abundance was extremely low during the survey period. This reflects the baseline bog condition which is dominated by bare peat with little vegetation present to provide foraging opportunities for butterfly species. The majority of the transect crosses bare peat, with some scattered poorly developed vegetation present in the wider area of the transect. In general, little or no pollinator activity was clearly associated with bare peat or recently rehabilitated bare peat areas.

Discussion

The baseline scenario for Edera still very much reflects habitats comprised largely of bare peat, and on this basis the ongoing monitoring for butterflies and other pollinators may be useful in determining the effects of rehabilitation under the EDRRS scheme on Pollinators.

It is possible species richness and abundance may increase in future surveys along the transect route when the rehabilitated area begins to revegetate. The effects of fertiliser application in particular to headlands and high fields may increase the rate of colonisation by some species.

Table 2.19.3: 2022 – Monitoring YR1 Pollinator Survey Results

Species	May	June	July	August	Total
Peacock *Aglais io*	0	0	1	0	1
Total	0	0	1	0	1

2.19.3 Surface Water Quality

Edera bog has six treated surface water outlets that discharge to the Ledwithstown IE_SH_26L840850 water body via the Bilberry River which is a sub catchment and main receiving water of Edera Bog.

Three of these outlets are monitored as part of EDRRS (SW98, 95 & 97) and the location of these outlets are shown on Drawing No. BNM-DR-22-04-32 in Appendix T0.

Analysis over 5 years of the IPC licence environmental monitoring of some of the discharges from this bog indicates that relevant parameters like Suspended Solids had an average of 5.06mg/l, with Ammonia averaging 0.138 mg/l, as per results below.

Table 2.19.4: Edera Bog IPC Licence Monitoring Results

Bog	SW	Monitoring	Sampled	pH	SS	TS	Ammonia	TP	COD	Colour
Edera	SW-97	Aug-20	18/08/2020	6.9	<2	189	0.473	<.05	91	416
Edera	SW-95	Sep-20	19/08/2020	7.3	2	293	0.209	<.05	78	393
Edera	SW-95	Q1 20	24/03/2020	8.1	2	371	0.064	<.05	17	50.7
Edera	SW-96	Q1 20	24/03/2020	8.3	5	284	0.075	<.05	54	202
Edera	SW-97	Q1 20	24/03/2020	7.9	2	268	0.085	<.05	20	51.3
Edera	SW-98	Q1 20	24/03/2020	7.8	2	343	0.213	<.05	41	157
Edera	SW-99	Q1 20	24/03/2020	8.2	6	376	0.067	0.1	39	119
Edera	SW-94	Q3 17	14/08/2017	8	9	399	0.1	<.05	36	77
Edera	SW-95	Q3 17	14/08/2017	7.7	8	286	0.37	0.1	41	155
Edera	SW-96	Q3 17	14/08/2017	7.9	5	318	0.17	<.05	41	108
Edera	SW-97	Q3 17	14/08/2017	7.8	5	316	0.02	0.07	28	72
Edera	SW-98	Q3 17	14/08/2017	8.1	10	354	0.09	<.05	34	66
Edera	SW-99	Q3 17	14/08/2017	8	5	380	0.02	<.05	17	32
Edera	SW-95	Q3 16	12/09/2016	7.1	5	154	0.09	<.05	97	315
Edera	SW-96	Q3 16	12/09/2016	7.5	5	216	0.03	0.09	63	121
Edera	SW-97	Q3 16	12/09/2016	7.6	5	250	0.14	0.07	64	122

Monthly EDRRS baseline monitoring commenced in October 2020, which gave 21 sampling events for this report, up to June 2022. During the monitoring period, suspended solids remained well within the associated emission limit value, with an average of 4.4mg/l at outlet SW98, 2.6mg/l at outlet SW95 and 3.6mg/l at outlet SW97. Similarly, Ammonia had an average of 0.196 mg/l, which is slightly above than when the bog was in active production and with all three emission points having varying trends from no change to increasing/decreasing.

Edera rehabilitation commenced in May 2021 and since then overall trends remaining largely unchanged during the period with no obvious clear relationship between rainfall and concentration of run-off at this location. During this period with significant drain blocking and cell formation, there were no noticeable peaks in suspended solids.

As monitoring of this bog continues in 2022 and on into the next monitoring cycle, any identifiable trends post rehabilitation will be easier to validate and link to the expected improving trend in water quality from this bog.

In addition, pH can also be another indicator of changes in a bog's hydrology, where an undrained peatlands hydrology will retain more rainwater and will therefore be more acidic. Previously drained peatlands will have a less retention of rainwater and a possible introduction of groundwater where the peat depth is shallow, where it may be influenced by groundwater and may have pumping/active drainage. The average pH during the period at this bog was 7.32.

Surface water monitoring for the period and associate graphs are in Appendix T3.

2.19.4 Archaeology

Edera bog was included in the National Monuments Service archaeological monitoring programme. carried out by Archaeological Management Solutions (AMS).

Edera Bog, Co. Longford, was visited on sixteen occasions during the rehabilitation works. The primary purpose was to monitor the ongoing rehabilitation works including cell formation and drain blocking and to inspect the peat fields and drain sections across the bog for any possible archaeological features. Conditions under foot varied from dry and stable from August to October but gradually became wetter and softer from November to January resulting resulting in raised water levels in many of the cells and drains. Drainage pipes and or sheet piles were subsequently placed in the berms of existing cells throughout the bog to ensure a water level beneficial to sphagnum moss growth.

No new archaeological features of significance were recorded. On the 15 December 2021, a site inspection of Edera Bog by AMS Senior Supervisor Alan Healy recorded three elements of worked wood in areas associated with drain blocking in the west of the bog. These three elements were divided into two separate sites: LF-Edera-01 and LF-Edera-02.

No archaeological finds were discovered and reported during the rehabilitation measures. During the initial Archaeological Impact Assessment desk study, all the 60 surviving sightings of archaeology identified were preserved *in situ* and avoided by the rehabilitation works with a 20m buffer zone.

2.19.5 Aerial Imagery / LiDAR

Edera Bog aerial images available prior to the commencement of the rehabilitation date from May 2020 and LiDAR was flown in November 2020 prior to the commencement of rehabilitation. On completion of the first year of EDRRS rehabilitation, an aerial survey of Edera Bog was carried out in June 2022 and updated LiDAR and aerial imagery was produced showing the rehabilitation completed at the time. This imagery and LiDAR is available to view on the EDRRS dashboard.

3. Carbon Monitoring (General)

Research to date, found that industrially extracted bogs are large sources of CO_2, DOC and POC while CH_4, nitrous oxide (N_2O) and dissolved inorganic carbon (DIC) are usually found to be insignificant (Evans et al., 2017). In rewetted bogs, the emission of CO_2, DOC and POC is reduced due to the high-water table levels while due to anaerobic conditions CH_4 emissions increase (Evans et al. 2017). Given these dynamics, the aim of this monitoring and verification program is to investigate the most significant GHGs that are associated with industrially extracted bogs (bare peat) and to quantify the

impact of rewetting on GHGs emanating from peatlands. GHG flux dynamics are also likely to vary over time starting with the bare peat emissions which are often complicated by the need to account for inter-annual variability. Following rewetting, the short-term change in morphology such as the creation of bunding and drain blocking resulting in pooling water on bare peat, are likely to influence GHG flux dynamics resulting in potentially elevated CH_4 emissions. The longer-term impact of habitat regeneration such as where rewetted peatlands reach a climax state will also have GHG flux dynamics that are unique to that new peatland state albeit closer to natural peatland GHG fluxes (Kreyling et al. 2021).

The carbon monitoring and verification program addresses these requirements via the establishment of four monitoring campaigns. The overall aim of these campaigns is to address the variation of habitats that current and future habitats and also account for the different time scales where GHG fluxes may have particular dynamics (short term and long term variation). The campaigns include a chamber measurement program, designed to estimate emission factors for CO_2 and CH_4 from habitats that are frequently present or expected to be present on Bord na Móna bogs. The second monitoring campaign involves the establishment of two Eddy Covariance towers that will be used to estimate baseline emissions from peat and the short-term impact of rewetting and habitat rehabilitation. This option has the potential to measure long term changes. However, this is outside the scope of this project. Thirdly, flumes and continuous DOC and POC will be measured at the flux tower sites. This will provide emission factors for baseline bare peat and the short turn impact of rewetting. Lastly, under the EDRRS enhanced surface water monitoring program, DOC and POC grab samples across EDRRS bogs will be used to estimate emission factors for current and future climax habitats that are present following both rewetting and habitat regeneration.

3.1 Desktop/Geospatial Review

To conduct the chamber monitoring campaign, habitats that would require monitoring needed to be identified. To accomplish this, a decision tree was developed to representative current Bord Na Mona land cover characteristics and the likely succession pathways. This involved conducting a geospatial analysis to identify the zonal statistics per habitat types within Bord na Móna peatlands and these were quantified using ArcGIS Map 10.6. Initially, this analysis was completed using Bord na Móna General Habitat Maps.

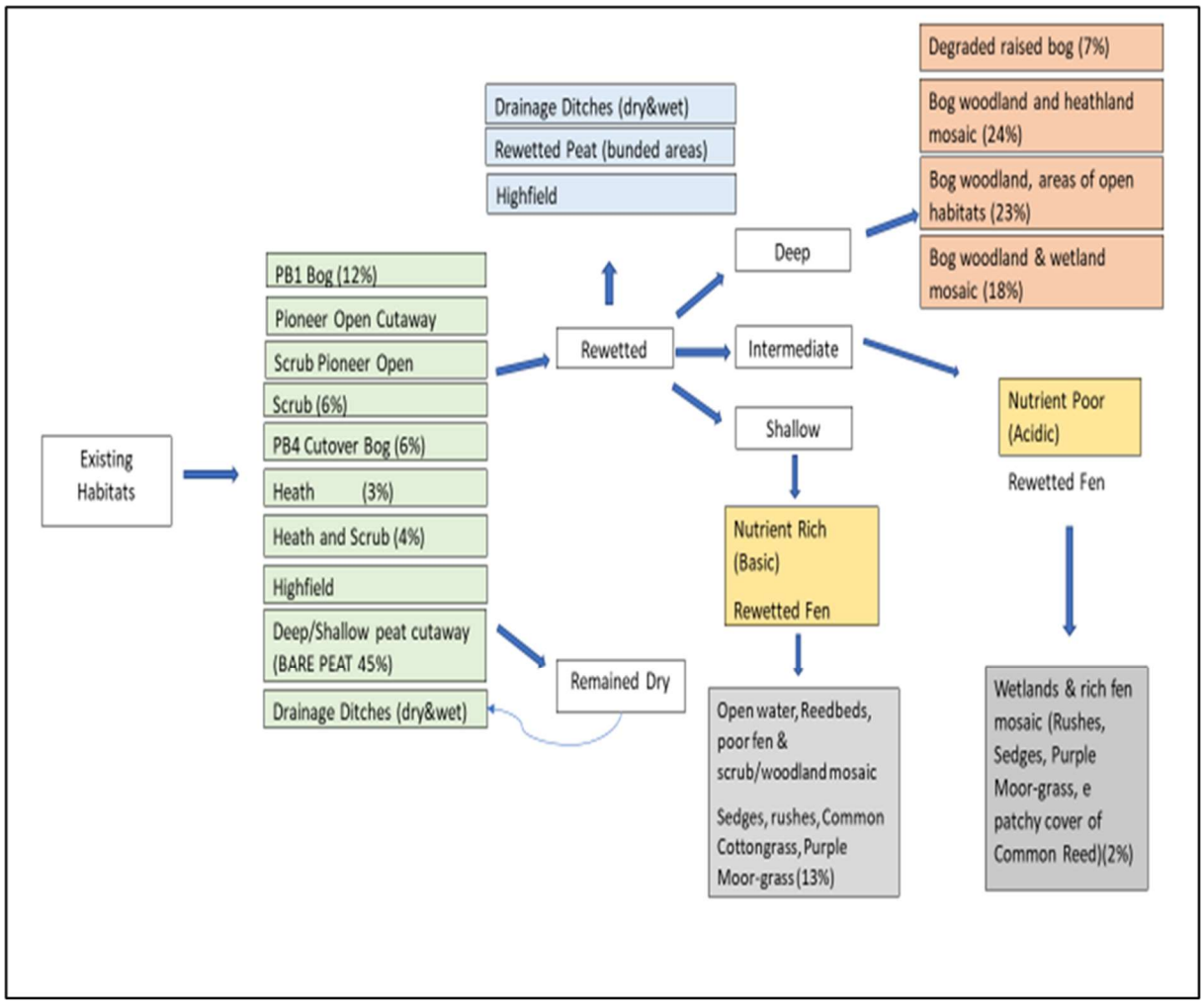

Figure 1.1 Decision tree used to identify which habitats will colonise in bare peat rewetted sites. This was using the General Habitat maps and a similar analysis will be conducted using vegetation types, hydrology and water chemistry.

In summary, this decision tree identified that two factors needed to be considered when choosing habitat locations. First, considering the large number of habitats and vegetation types present on Bord na Móna bogs, only habitat types that contributed significantly to the overall area can be included for monitoring. Second, that vegetation alone was insufficient to identify chamber locations and that hydrology, peat depth and water chemistry, where possible, should be used to select chamber locations. This conclusion was reached in conjunction with feedback from the NPWS at Ecology Workshops in July and October 2022. This analysis is currently ongoing and is expected to be completed in early 2023.

Prior to this analysis being available for use, area statistics related to vegetation coverage were generated to help identify where to locate chambers. This analysis identified important habitats that should be monitored using the closed static chamber method. Using the area statistics, habitats found on Bord na Móna peatlands were quantified for both the current land bank and future habitats as shown in Figure 3.2 below.

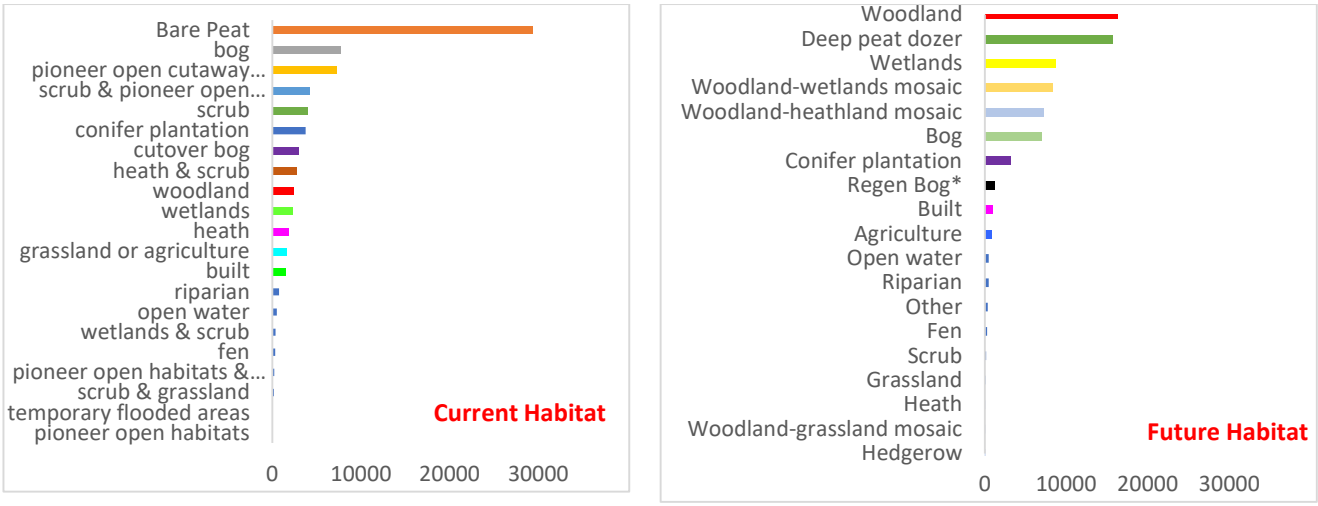

Figure 3.2: Zonal Statistics on Bord na Mona bogs. These habitats types are classified by Bord na Mona as the General Habitat Classifications. Future iterations of this analysis will be conducted using detailed habitat classification. Chamber measurements will be conducted using individual vegetations types and combined to account for the mosaic nature of Bord na Mona Bogs.

The general habitat maps used in this analysis, grouped commonly occurring vegetation types to represent typical land cover on Bord na Mona bogs. These lands often contain mosaics of vegetation and the general habitat maps are useful in defining land in terms of establishing if the peatland is on fen or raised bog trajectory, stage of re-colonisation (if not bare peat) and can indicate if an area is wet (transitional fen like habitats) or dry (heather dominated peatlands). However, these broad categories are problematic for conducting chamber measurements which typically only measure single vegetation types albeit it is possible to measure multiple species if they are present in a single collar. However, one aim of the monitoring program is that the emission factors can be aggregated to the general habitats level and disaggregated to single vegetation types. This flexibility would mean that multiple end-users can use the output from this project to model or inform on policy development. To achieve this, the Bord na Móna detailed habitat maps were used to identify the most significant mosaics that were associated with each general habitat type. Area statistics were obtained using ArcGIS 10.6.1. The results from this analysis are described in Table 3.1 below. This analysis was not completed for the Future Habitat Maps as the detailed habitats are not yet available.

3.2 Collar Installation

Based on the geospatial analysis, sites were first inspected to ensure that they had the correct vegetation and peat depth, piezometers were in proximity, the sites were isolated and no obvious security issues existed. Collars were inserted into the study site to a depth of 12cm using a root saw or spade to clear roots to enable collar insertion. Collars were levelled to ensure that the chamber could achieve a tight seal. An example of this collar insertion is shown if Figure 3.3 below. A measurement was not taken on the collar for at least one week and in most cases several weeks.

Figure 3.3 Collar placement over Eriophorum angustifolium located in Ballycon, Co. Offaly

Table 3.1 describes the locations selected for chamber measurements. A total of 21 chamber sites and approximately 44 individual collars (plots) are currently installed across EDRRS bogs. It is anticipated that further plots may be installed once the geospatial analysis is completed while some locations may become less important or emission factors from previous studies may be used. The table describes the chamber study locations in terms of peat depth, average pH and average water table level. It is anticipated that this data will be important when the geospatial analysis is completed. The chamber measurements program was initiated on the 2nd June 2022. To date 41 chamber measurements have been taken at over 5 bogs and 12 habitats.

Table 3.1: Locations selected for chamber measurements selected following geospatial analysis of Bord na Mona land bank and modelled future habitats

General Habitat %	Detailed Habitat	Vegetation	Location	Peat Depth	Mean pH	Water Table	No. of samples
PB1 Bog (12%)	PB1 Bog (12%)	Sphagnum spp.	Mouds, Co, Kildare	5.9m	4.57	-20 to -40cm	2
			Clonad, Co. Offaly	1.46m	4.07	-34 to -54cm	4
Pioneer Open Cutaway (11%)	Mosaic of bare peat & pioneer Eriophorum angustifolium-dominated poor fen (9%)	Eriophorum angustifolium	Ballycon Co. Offaly	1.2m	5.84	Piezometer to be installed	3
	Mosaic of bare peat & pioneer Juncus-dominated poor fen (16%)	Juncus	Ballycon Co. Offaly	TBC	TBC	TBC	TBC
Scrub Pioneer Open Cutaway (11%)	Mosaic of open Betula scrub & pioneer Juncus-dominated poor fen (20%)	TBC	TBC	TBC	TBC	TBC	TBC
	Mosaic of emergent Betula scrub & pioneer Juncus-dominated poor fen (17%)	Juncus and Emergent Birch (Separate Collars)	Derries, Co. Offaly	2.1m	Nan	Dry	3
	Mosaic of bare peat, pioneer dry Calluna-dominated heath & emergent Birch scrub (2%)	Calluna Vulgaris and Bare Peat (Separate Collars)	Mouds, Co, Kildare	3m+	4.21	-20.5cm	3
Scrub (5%)	Closed Betula-dominated scrub (38%)	Grasses (Woodland Floor)	Derries, Co. Offaly	0.3m	6.61	NAN	3
	Scrub (WS1) (35%)	Molinia Grasses and Calluna Vulgaris (Separate Collars)	Clonad, Co. Offaly	3m+	4.54	-51cm	4
	Open Betula-dominated scrub (16%)	TBC	TBC	TBC	TBC	TBC	TBC
Cutover Bog	PB4 Cutover Bog	Calluna Vulgaris and Sphaghum spp. (Separate Collars)	Mouds, Co, Kildare	3m+	3.87	Piezometer to be installed	3
	PB4 Cutover Bog	Eriophorum Angustifolium, Calluna Vulgaris, Molinia Grass	Clonad, Co. Offaly	3m+	TBC		
Heath (3%)	Pioneer dry Molinia-dominated grassland (15%)	Molinia Grasses	TBC	TBC	TBC	TBC	TBC
	Pioneer dry Calluna-dominated heath (59%)	Calluna Vulgaris	Carranstown, Westmeath	4.9m	4.41	-50cm	3
		Calluna Vulgaris	Mouds, Co. Kildare	3.2m	4.73	-42cm	2
Heath and Scrub (4%)	Mosaic of pioneer dry Calluna-dominated heath, open Betula-dominated scrub & dry Molinia-dominated grassland (15%)	Calluna Vulgaris, Mollina Grasses, Emergent Birch (separate collars)	Clonad, Co. Offaly	0.5m	4.4	-29cm	4
	Mosaic of pioneer dry Calluna-dominated heath & emergent Betula-dominated scrub (17%)	Culluna Vulgaris	Mouds, Co. Kildare	4.4m	4.26	-50.5cm	3
	Mosaic of open Betula scrub & pioneer dry Calluna-dominated heath (35%)	TBC	TBC	TBC	TBC	TBC	TBC
Woodland (3%)	**Woodland (3%)**	Established Birch Woodland Soil	Carranstown, Westmeath	2.3m	4.4	-100cm	3
		Emergent Birch Spaghnum Spp	Ballycon Co. Offaly	1m	7.79	Piezometer to be installed	1
		Birch and Conifer Mix	Lullymore, Co. Kildare	TBC	TBC	TBC	TBC

3.3 Closed Static Chamber Field measurements

Closed static chamber measurements are anticipated to be measured at fortnightly intervals during the growing season and monthly intervals during the non-growing season. The Net Ecosystem Exchange (NEE), Ecosystem Respiration (Rs) and Methane (CH4) fluxes are measured using a Licor 7810 trace gas analyser. The main chamber consists of polycarbonate sheets (Maier et al. 2022) (60cm*60cm*50cm), an internal fan to ensure mixing and an Apogee SQ-520 Photosynthetic Active Radiation (PAR) Sensor to measure Photosynthetic Photon Flux Density (PPFD). The internal temperature of the chamber is measured using an Atlas Scientific Temperature probe which is inserted into a small radiation shield. Temperature is monitored during the chamber closure time and if temperatures vary greater than 4^{o}C the measurement will be discarded and re-taken (Wilson *et al*. 2016). During warm periods, a cooling system will be used (e.g. ice packs) to maintain temperature at ambient levels (Wilson *et al*. 2022). To ensure enough fluxes are recorded at different light levels, three chamber measurements will be taken per collar. One measurement will be taken with the clear chamber, a semi-transparent sheath will be used for a second measurement and a third measurement will be taken using a dark sheath to simulate night-time respiration (Maier *et al*. 2022). In addition, to ensure that chamber measurements are taken at higher light levels, measurements will be taken different times of the day. Specifically, measurements will coincide where peak sunlight is anticipated to ensure that sufficient model accuracy can be achieved.

A second type of floating chamber will be used to measure fluxes from aquatic environments. Three floating chambers were built from polycarbonate sheets (25cm*25cm*25cm). To simulate different light levels, one chamber will be clear, one opaque and one will be covered in aluminium foil (to simulate night-time respiration). The same set-up will be used as described already. (Maier *et al*. 2022).

Standard chamber measurements are taken over 3 minutes and 30 seconds with the first 30 seconds for mixing (Maier *et al*. 2022). In certain conditions, the chamber closure period will be amended to shorter time periods (where excess water vapour or pressure increases are present) or longer closure times where fluxes are smaller (Maier *et al*. 2022). A raspberry pi will be used to automate the measurement protocol where measurements were read every 2 seconds from the Licor 7810 and averaged over a 30 second period. Each 30 second average is automatically plotted to assess the linearity of the measurement and is viewable on a hand-held tablet. (Maier *et al*. 2022).

3.4 Closed Chamber Flux Calculation

Chamber field measurements that have a co-efficient of determination of 0.90 or greater are accepted. Where a field measurement is accepted, it is input into a flux calculation (Fc):

Equation 1: $$F_c = \frac{10VP_0(1-\frac{W_0}{1000})}{RS(T_0+273.15)}\frac{\partial C\prime}{\partial t}$$ (LICOR,2019)

Where V is the chamber Volume (m3), P is the Air Pressure (Hpa) (taken from nearest Met Eireann Station), W0 is the initial H2O concentration (mmol/mol), R is the ideal gas constant (8.3144), T0 is air temperature taken from nearest Met Eireann Station (Kelvin), ∂C' is the change in CO2 or CH4 concentration and ∂t is the time elapsed (seconds).

3.5 Site Configuration

Each chamber monitoring site will include a boardwalk to prevent disturbance, a piezometer with continuous measurements (Rugged Troll 100 loggers), and continuous monitoring of soil temperature and moisture and PAR sensors (currently in procurement). In addition, spot measurements of water table levels via dip-well method, soil water pH (YSI Pro 10 Professional Plus), soil moisture, temperature and conductivity (PICO 64 200mm temperature, moisture content & electrical probe) at each collar and Leaf Area Index (LAI) were also taken using a Licor 2200C. Peat depth was also taken using a peat depth probe stick.

3.6 Modelling Flux Measurements to Annual Fluxes

To model annual GHG fluxes, closed static chamber flux measurements are used in conjunction with soil temperature, moisture and PPFD data as inputs into carbon models that can estimate annual fluxes from that location.

The NEE is the net exchange of CO_2 from an ecosystem or habitat and consists of two terms as show in Equation 2:

Equation 2: $NEE = -GPP + R_s$ (Billet *et al*. 2010)

Where NEE is the net ecosystem exchange, GPP is gross primary production and R_s is the ecosystem respiration. Negative values indicate sequestration while positive values indicate emission

As both NEE and Rs are directly measured, GPP is estimated by re-arranging Equation 2 to:

Equation 3: -GPP = Rs – NEE

Gross Primary Production (GPP)

GPP can be related to PAR using the Michaelis–Menten-type relationship that describes the saturating response of photosynthesis to light and soil temperature (Tuittila *et al*. 1999, Wilson *et al*. 2016). This involved developing a light response curve that characterises the relationship between GPP and changes in light levels. Coefficients are used to describe this relationship, and these will be obtained using Python Scipy optimize module using the Levenberg–Marquardt multiple nonlinear regression technique (Wilson *et al*. 2016). PAR sensors located at each bog takes measurements at hourly intervals where chamber measurements are occurring will be used to estimate GPP measurements. Equation 4 obtained from Wilson *et al*. (2022) was used to model GPP fluxes:

Equation 4: $GPP = GPP_{max}\left(\frac{PPFD}{PPFD + k_{PPFD}}\right) * (\exp(a * T10))$

where GPP is gross primary production, GPPmax is maximum photosynthesis, PPFD is photosynthetic photon flux density, kPPFD is the PPFD value at which GPP reaches half its maximum, and T5 is the soil temperature at 5 cm depth.

3.6.1 Ecosystem Respiration (Rs)

Ecosystem respiration is the exchange of CO2 from plant derived processes (Autotrophic respiration) and from microbial breakdown of organic material (Heterotrophic respiration). Similar to GPP, a temperature response curve was used to identify coefficients that enabled the relationship between soil temperature and Rs to be described and then used to model annual fluxes using Equation 5 used in Wilson *et al*. 2022.

Equation 5: $$R_S = \mathrm{a} * \exp\left[b\left(\frac{1}{T_{REF}-T_0} - \frac{1}{T5-T_0}\right)\right]$$

where Rs is ecosystem respiration, T_{REF} is reference temperature set at 283.15 K, T_0 is the (minimum) temperature at which respiration reaches zero and is set here at 227.13 K, T5 and T10 are the soil temperature at 5 cm, respectively, and a and b are fitted model parameters.

Using modelled GPP and Rs, the NEE will be calculated as the difference between the two processes using Equation 2.

3.6.2 Methane (CH4) Fluxes

Methane fluxes occur because of anaerobic breakdown of organic material within the peat profile. The emission of methane is mediated by ebullition processes (sudden and large emissions), plant mediated transport pathways and diffusive transport processes like concentration gradients (Maier *et al*. 2015). Methane fluxes are estimated using Equation 6 used by Wilson *et al*. 2022.

Equation 6: $$CH_4 = (\exp\ (a * T_{5cm}))$$

where T_{5cm} is soil temperature at 5 cm depth, and a is a model parameter.

3.6.3 Radiative Forcing Models.

Radiate forcing models similar to Wilson *et al*. 2022 will be investigated and reported on in the next annual monitoring report in 2023. A significant concern in rewetting bogs is the impact that strong radiative forcing gases may have on the overall GHG balance. Wilson *et al*. 2022 and Günther *et al*. 2019 both found that despite the radiative warming influence of CH_4, the avoided CO_2 emissions, and in time sequestration, offset the net warming effect. Bord na Móna will seek to follow a similar approach to these studies and provide further evidence to the benefits of peatland rehabilitation.

3.7 Eddy Covariance Towers

The overall aim of using Eddy covariance towers is to evaluate the real-time impact of rehabilitation measures on carbon fluxes. Bord na Móna peatlands can be characterised by depth given the homogeneous nature of bare peat and it is therefore appropriate to categorise these peatlands based on depth. This distinction is important because peat depth is likely to be an important indicator of its future rehabilitation trajectory whether it be towards a nutrient poor raised bog or fen, or alternatively towards nutrient rich fen. Therefore, flux tower placement needs to account for the most frequently occurring peat depths on Bord na Móna bogs.

To achieve this, ground penetrating radar (GPR) and Lidar survey data indicating peat depths was used to estimate peat depths for three broad categories: shallow peat (<1.5m depth) intermediate (1.6-2.4m) and deep peat (2.5m+). This analysis conducted over 25000 hectares found that the most frequently occurring peat depth was shallow peat which accounted for 51% of Bord na Mona peatlands followed by deep peat which accounted for 27% as illustrated in Figure 3.4 below.

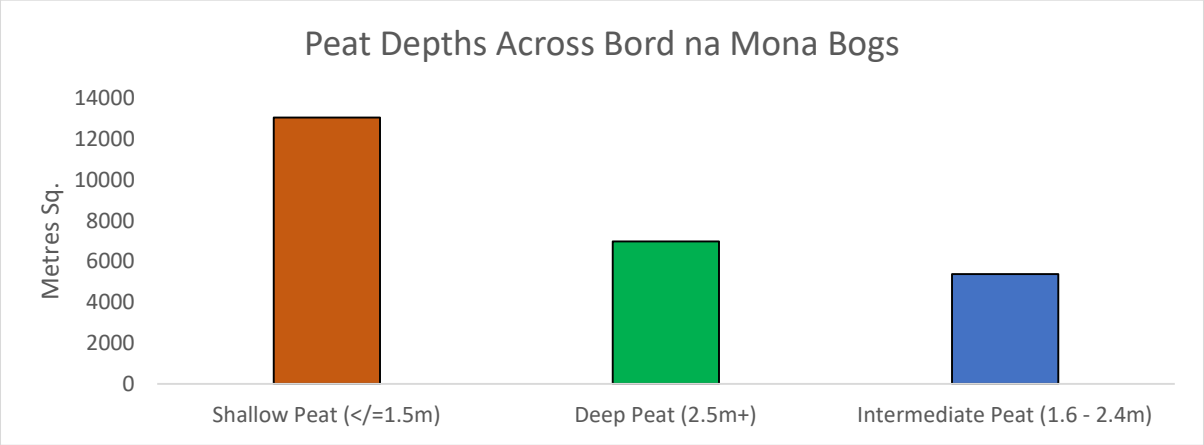

Figure 3.4 Bar plot showing peat depths over 25,000 hectares of Bord na Mona peatlands. The plot indicated that the most frequently occurring peat depth is shallow peat.

Given the that two most frequently occurring peat depths are shallow peat and deep peat, sites that were shallow peat and deep peat were selected for Eddy Covariance monitoring. Several sites were investigated with consideration given to factors like security, internet access, presence of peat stock, access to electrical grid and schedule of works (at least one year of baseline data was required before rewetting). [redacted]

3.7.1 Eddy Covariance Tower Location 1 [redacted]

The selected bog [redacted] was developed and drained for peat production in the 1970's. This process of draining the bog took 5 years and was completed in 1979. The bog was harvested for peat for the next 30 years before Bord na Mona ceased all peat production. [redacted]

Ballaghurt drains into the River Blackwater at the southern section of the bog. The footprint of the tower is 270m. The peat depths within that footprint are on average 2 metres deep (Std. Dev = 1.05m). The maximum peat depth within the tower footprint is 3.65 metres depth, and the minimum is 0.0 metres. The prevailing wind direction (West, North-West as shown in Figure 3.6) indicates that the footprint is likely to focus on shallow peat. Deeper peat in located to the south of the flux tower. The flux tower is located to ensure it is a safe distance from the roadside. Contingency plans are in place

to amend the site setup should the prevailing wind direction change, or the footprint is outside our area of interest in which case the tower will be moved. Alternatively, the height of the tower can be increased therefore increasing the footprint size. The eddy covariance software is capable of extracting areas of interest from within the footprint ([redacted]

The eddy covariance tower was first set up in a laboratory to ensure that all parts were received and in working order. It was subsequently installed on the 25th of September 2022 [redacted] The tower is powered by four 12V batteries connected in parallel which are in turn powered by two arrays of five 350W solar panels connected in serial.

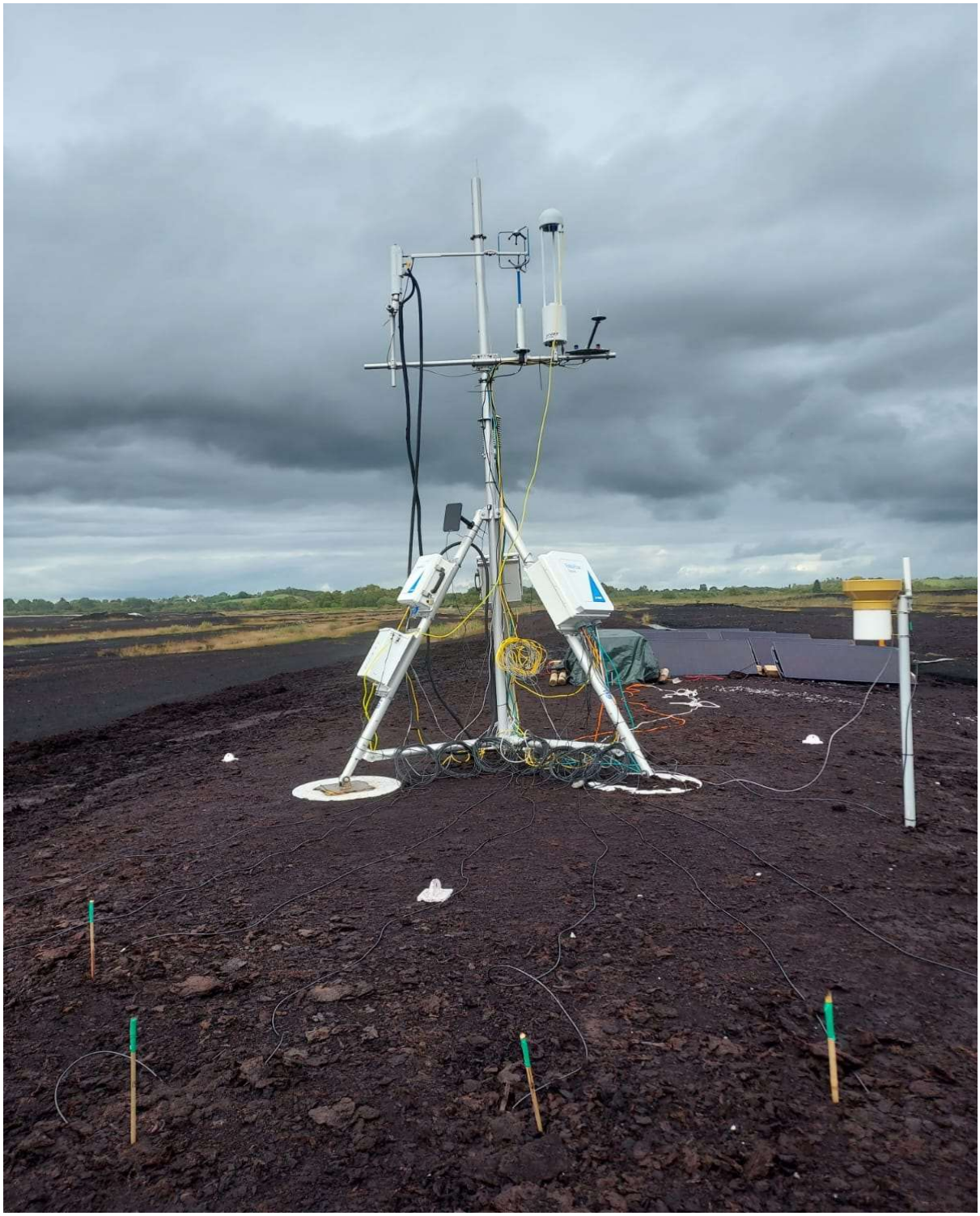

Figure 3.6: The Eddy Covariance tower capable of measuring CO_2, CH_4, meteorological Variables, surface energy balance components

[redacted] Eddy Covariance Tower Location 2 [redacted]

[redacted]

The bog where the second tower is to be located [redacted] was first developed in the late 1980's and is a deep peat bog. [redacted]

[redacted] Peat production on the site ceased in 2020 in line with other Bord na Mona production bogs. The proposed location is anticipated to have a 250m footprint and has an average peat depth of 4.36m (Std Dev = 0.9m) with a maximum peat depth of 6.14m and a minimum peat depth of 0.59m. Installation is proposed to occur on this site shortly and be installed before January 2023.

3.8 Aquatic Carbon Losses

Previous studies have estimated that aquatic losses are significant contributors to the overall GHG balance of industrially extracted bogs (Evans et al. 2017). In addition, significant reductions were found upon rewetting, indicating that measurement of aquatic losses is valuable in quantifying the overall carbon benefit of the Bord na Móna rehabilitation program.

The monitoring and verification program aims to monitor DOC and POC at the bogs where the Eddy Covariance towers are located [redacted] Four RBC type flumes will be installed (two at each bog) and placed in bare peat catchments. The aim of this monitoring program is to develop baseline DOC and POC emission factors for bare peat and for rewetted peatlands following rehabilitation in the short term. DOC will be measured using a Photonic Measurements UV254 Probe while POC will be measured via grab samples and analysed via loss on ignition techniques in an external accredited laboratory (in procurement process) following the methods outlined in (Ryder et al. 2014)

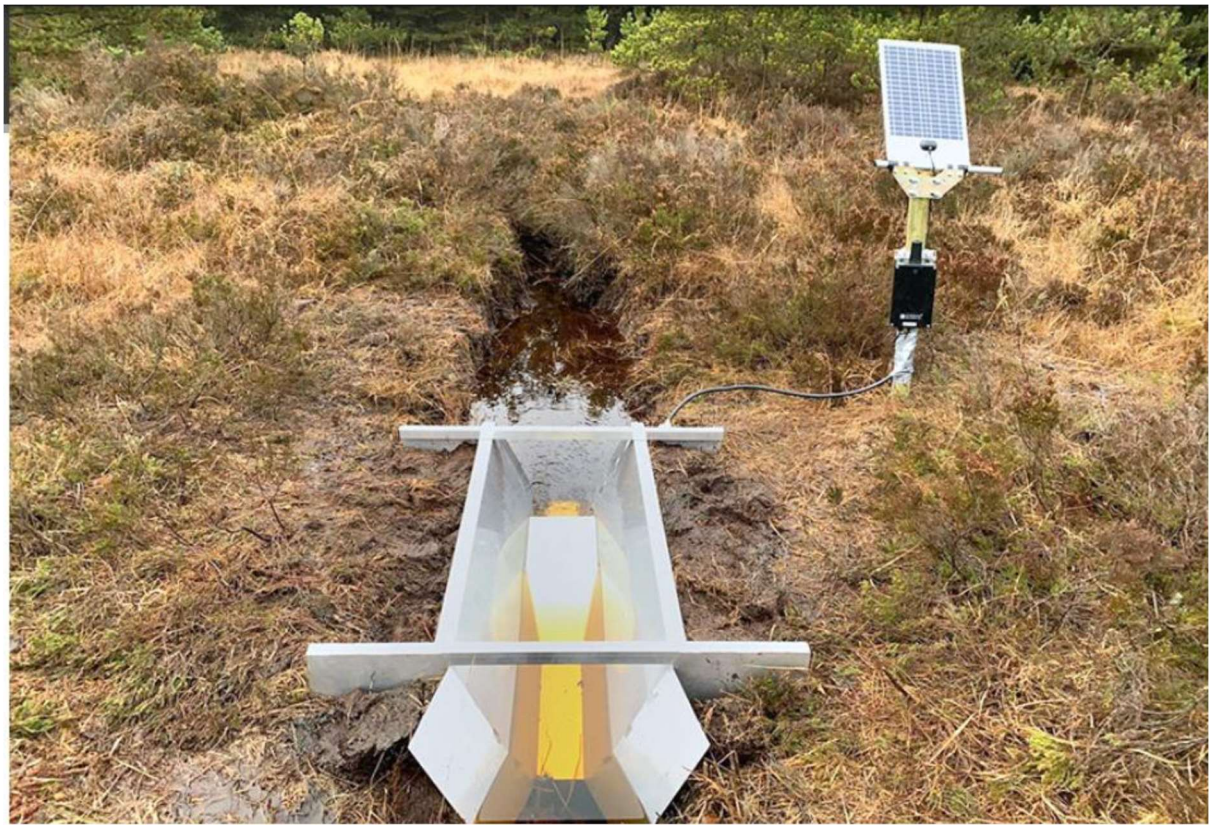

Figure 3.8: RBC Flume

The Site 1 [redacted] flumes will be located in deep and shallow peat catchments. The deep peat site is located at the south western region of the bog in a catchment of approximately 42 hectares. The second flume is located in a 10-hectare catchment in the north east of the site in a mix of intermediate and shallow peat.

[redacted] is the second bog location that is identified for flume installation and aquatic carbon monitoring. This location was selected because as it is also the location for the flux tower and represents a bare peat bog.

The [redacted] flume locations figure 3.11 are in close proximity to each other as shown on Figure 3.11 This Figure also shows a catchment of 9.33 hectares and a second catchment of 8.45 hectares. Both flume locations drain intermediate to deep peat.

3.8.1 Flume Installation

For the installation of the [redacted] channels will be created to insert the flumes in the production fields where the field drains merge into the main channel draining into the silt pond. The channels will be inserted to ensure that flow and water depth are within the requirements of the flume DOC probe.

DOC and POC emission factors will be developed using both the continuous DOC and grab sample POC measurements. These emission factors will reflect bare peat conditions and the immediate impact of rewetting. In conjunction with this, enhanced surface water monitoring is ongoing across the EDRRS sites. Grab samples of DOC have been monitored since 2020 across these sites and POC will be monitored from 2023. These will also be used to develop habitat specific emission factors where possible.

4. Flow Monitoring

Flow monitoring of surface water discharge from the peatlands is not an integral part of the monitoring programme for EDRRS bogs, however some flow monitoring of bogs is underway as set out below.

4.1 Provision of Flumes

The installation of flumes is discussed in Section 3.8 above. While the purpose of these flumes is to quantity carbon aquatic losses, they will also provide a record of the flow from these bogs. These flumes will be located on the same bog as the carbon flux towers where rainfall is measured. These readings, combined with the catchment size, will give an indication of the run-off from bare peat bogs before rehabilitation is carried out and after rehabilitation has been implemented.

4.2 Monitoring of flow using probes

Three flow monitoring probes have been installed on bogs to be rehabilitated under EDRRS. One of these probes is located in a Year 1 EDRRS Bog, namely [redacted] The other two are located in [redacted] both of which are currently being rehabilitated as part of the Year 2 EDRRS rehabilitation programme.

The 2150 velocity flow module installed at each location measures liquid level and average stream velocity and calculates the flow rate and total flow. The liquid level and velocity measurements are read from an attached AV Sensor that is placed in the flow stream within a pipe. Power supply is provided using a solar panel and a rain gauge is also provided at each location.

The probe in [redacted] is located south of an area [redacted] which was in peat production until 2018 as shown in Figure 4.1 below. Flow data for the period January 2020 to August 2021 is available the majority of which is prior to the commencement of the rehabilitation measures. Work was required on the probe and following re-installation, flow monitoring commenced again in June 2022 and is ongoing. Rehabilitation was 95% complete in [redacted] at this stage. The flow data from these probes is exported and can be viewed and downloaded remotely using Flowlink software.

The velocity probe in [redacted] was installed in June 2022 and the probe in [redacted] was installed in May 2022. Due to the dry summer there was no flow in [redacted] pipe during the summer period, however data has been available from this probe since September 2022.

An example of the set up for the flow monitoring probe is shown on Figure 4.2 below.

Figure 4.2: Flow Monitoring Velocity probe- Probe is installed in the pipe with the rain gauge, solar panel and container with data logger visible in the background.

4.3 Monitoring of flow - Composite Samplers

Composite samplers have been installed in the following Year 1 EDRRS Bogs

[redacted]

In addition, composite samplers have also been installed in the following EDRRS bogs where rehabilitation has commenced or is due to commence in future years:

[redacted]

While these composite samplers have been installed to sample the surface water discharging from the bog, these samplers also automatically measure the flow. Flow data from these samplers has not yet been downloaded, however it is expected that this data will be available in the coming months.

5. Baseline Monitoring additional to the Year 1 Bogs

While this report is focussed on the year 1 EDRRS Bogs, monitoring is also ongoing out on other bogs included in EDRRS as set out below.

5.1 Piezometers

While not possible for the year 1 bogs, in general the piezometers are installed so that one year's baseline data can be gathered in advance of rehabilitation. Piezometers for the bogs to be rehabilitated in Year 2 (2022) were installed in Summer 2021 and likewise those bogs to be rehabilitated in Year 3 (2023) had piezometers installed in Summer of 2022.

While it is preferable to continue the piezometer monitoring post rehab, it is proposed to recycle the hydrological monitoring equipment on a rolling basis with piezometers retained on site for a minimum of a full year, post rehab. The majority of the automated loggers will then be removed and relocated to other sites proposed sites for rehabilitation. Bord na Móna are supported by external professional services (RPS Consultants) in this part of the monitoring programme.

At the end of June 2022, 1146 piezometers had been installed on thirty eight bogs included in the EDRRS scheme and 431 of these had been equipped with an automated logger. Over 2,700 manual readings of the water levels in the piezometers had been taken and 199 loggers had been downloaded.

Ideally there will also be a permanent monitoring programme established to measure fluctuations in groundwater levels after rehabilitation has been implemented. Such permanent monitoring can only extend past the life of the scheme subject to funding availability. A stratified approach will be taken with selected sites that reflect the variation of environments (pumped drainage vs gravity drainage, deep peat vs shallow peat) and variation in rehabilitation measures. This will help inform and measure the expected benefits of enhanced rehabilitation in relation to optimising water levels for climate action.

5.2 Biodiversity

Biodiversity surveys are ongoing for the EDRRS Year 2 bogs, also referred to as FY23 bogs (See Table 5.2.1). Specific biodiversity surveys were stratified in line with the approach in Year 1. Not all sites have a breeding bird survey, for example. Breeding bird surveys (as part of Scheme Monitoring and Verification), breeding bird ecological restoration zone surveys (linked to Standard Operating Procedures for the protection of sensitive receptors) and Pollinator surveys (also as part of Scheme Monitoring and Verification) have been undertaken in respect of FY23 bogs. Fieldwork to inform habitat monitoring is ongoing. Wintering bird surveys for the FY23 bogs, covering the winter period of 2022/23 has commenced. A high level summary is provided below.

Table 5.2.1 EDRRS Year 2 Bogs. N/P = Not planned.

EDRRS Year 2 (FY23) Bogs	Breeding Bird surveys (Spring 2022)	Breeding Bird ERZs (Spring 2022)	2022 Pollinator Surveys	Habitat surveys (Fieldwork)	Wintering Bird Surveys (Aut 2022)
Bunahinly-Kilgarvan	Completed	N/P	N/P	75% complete	Started
Bloomhill	Completed	N/P	N/P	Completed	Started
Derryfadda	Completed	N/P	N/P	Completed	N/P
Derrybrat	Completed	N/P	N/P	Completed	Started
Carranstown	N/P	Completed	N/P	Completed	N/P
Prosperous	N/P	N/P	N/P	Completed	N/P
Clooneeny	N/P	Completed	N/P	Completed	N/P
Begnagh	N/P	Completed	Completed	Completed	N/P
Knappoge	N/P	Completed	N/P	Started	Started
Killaranny	N/P	Completed	N/P	Completed	N/P
Derrinboy	N/P	Completed	N/P	Completed	N/P
Cloncreen	N/P	Completed	N/P	Completed	N/P
Timahoe South	N/P	N/P	N/P	Started	N/P
Lodge	Completed	N/P	Completed	Completed	N/P
Glenlough	Completed	N/P	N/P	Completed	N/P
Noggusboy	Completed	N/P	N/P	Started	Started
Derraghan	N/P	Completed	N/P	Completed	N/P
Blackwater	Completed	N/P	Completed	30% complete	Started
Ballycon	N/P	N/P	N/P	Completed	N/P

Regarding findings much of the data gathered is still being processed however a high level overview indicates for instance that breeding bird assemblages are generally similar to those recorded in the EDRRS year 1 sites, with species of note including Curlew (recorded at Lodge Bog and known to breed in close proximity), [redacted]
Regarding Pollinators Marsh Fritillary has been noted from Lodge Bog and a colony of Grayling *Hipparchia semele* was discovered at Blackwater Bog; the latter is a scarce butterfly in Co. Offaly. It is too soon to summarise any habitat mapping findings.

5.3 Surface water monitoring

Surface water monitoring is ongoing for all the 82 bogs included in the original list of EDRRS bogs and also includes an additional ten bogs that have been added since the scheme commenced. In general, surface water monitoring is carried out under the scheme so that circa 70% of each bog's drainage catchments are monitored on a monthly basis. At the end of June 2022, over 3,200 samples had been collected and analysed on the EDRRS bogs. All samples are analysed for the following parameters:

pH, Suspended Solids, Total Solids, Total Phosphorus, Total Ammonia, Colour, COD (chemical oxygen demand) and DOC (dissolved organic carbon).

Variables that effect the achievement of obtaining suitable months samples include the following:

1. Surface water Emission points that are not discharging during the dryer summer months post an extended period of no rainfall.
2. Bogs close to Rivers impacted during the winter months from fluvial flooding, where the associated drainage is backed up and there is no actual discharge.
3. Surface water outlets that are inaccessible during the winter months when the access is hindered by high water levels.

In general, the main water quality impacts associated with peatlands and peat extraction, suspended solids and ammonia, are starting to demonstrate a reduction in concentration from the levels encountered prior to rehabilitation. However it is proposed that this level of surface water sampling will continue for the lifetime of the scheme, to be able to consider a suitable period post the completion of rehabilitation and validate and ongoing positive or negative trends that might indicate the trajectory being achieved.

5.4 Carbon Monitoring

The carbon monitoring currently proposed for EDRRS is set out in Section 3.0 above. It should be noted that there is ongoing discussion with NPWS in relation to carbon monitoring and the proposed monitoring may be amended throughout the lifetime of the scheme.

5.5 Flow Monitoring

The proposed flow monitoring for the scheme is set out in Section 4.0 above.

5.6 Archaeology

Archaeological impacts, both potentially positive and negative, are assessed in advance by the preparation of an Archaeological Impact Assessment by a suitably qualified Project Archaeologist. Any known archaeology is then added to the Bord na Móna GIS and an appropriate buffer zone, as advised by the Project Archaeologist, is applied to remove any rehabilitation measures from these zones.

These zones are identified on the bog and associated site maps, with procedures posted in all site offices to advise on the appropriate measures to be employed in the discovery of unknown archaeology during the implementation of the measures.

The National Monuments Service also monitored the rehabilitation on a number of sites during 2022, by engaging Archaeological Management Solutions (AMS), to periodically visit these sites during the year to assess how the management of known and unknown archaeology is being achieved.

6. Lessons Learned / Recommendations

Experience was gained and lessons were learned as the monitoring of the EDRRS scheme was implemented. Some of these lessons learned are set out below.

6.1 Lessons Learned

6.1.1 Availability of Baseline Monitoring

In the case of EDRRS there was very little time available, circa six months, from the announcement of the scheme to the commencement of the rehabilitation measures. As a result, it was not possible to gather significant baseline monitoring data on the Year 1 bogs. Baseline data such as ground water, habitat, updated vegetation, sensitive ecological receptors and water quality information is all useful in determining the rehab design for a bog as well as for the monitoring the response of the bog to rehabilitation. Prior confirmation on the extent or not of any sensitive ecological receptors would also allow for more forward planning and consequently a more streamlined integration of measures which minimise possible pathways for negative quality effects with rehabilitation whilst in progress. The provision of at least eighteen months from the announcement of a scheme to the commencement of rehabilitation should be considered for any future similar schemes.

6.1.2 Development of Dashboards to monitor Piezometer network

There is a significant piezometer network installed throughout the bogs within the scheme to monitor groundwater levels which in turn informs future design and the efficacy of the rehabilitation measures. To streamline this reporting process a web-based dashboard was developed which was not initially proposed. This dashboard provides an aid to all stakeholders where all the piezometer data is available in a format that will assist with future design and reporting. In addition, this dashboard and the actual piezometer network can be utilised to monitor the ground water results into the future beyond the time-line of EDRRS if deemed necessary.

6.1.3 Value of Annual Aerial imagery

The EDRRS financial model only included for the aerial imagery to be provided for the scheme at the commencement and also on completion of all the rehabilitation. Following discussions between NPWS and Bord na Móna it was agreed to procure aerial imagery of the Year 1 EDRRS bogs in Spring/ Summer of 2022. This imagery is of very high resolution and is very useful in providing evidence of the rehabilitation completed and allowing for comparison of this completed rehabilitation against the original design. This imagery also provides information on the extent of standing water on the bogs and in the cells, however this should be viewed cautiously as it is a snapshot at a particular point in time.

Subject to costs it is agreed by both NPWS and Bord na Móna that high resolution aerial imagery should be procured each summer for the bogs that have been rehabilitated the previous year.

6.1.4 Extent of Biodiversity Monitoring

The original EDRRS Financial model was not specific in describing the extent of biodiversity monitoring that would be carried out or required under the scheme. Since the commencement of the scheme, a number of workshops have been held with NPWS and Bord na Móna to define the extent of the monitoring required. The resources allocated to this Biodiversity monitoring in the original financial model for the scheme is likely not adequate to implement the level of monitoring now envisaged over the lifetime of the scheme. This will be closely monitored over the coming years.

It would be preferable if the extent of the biodiversity monitoring required was clearly defined prior to the commencement of the scheme and this should be considered for any similar scheme.

6.1.5 Appropriate Assessment

In line with the comments above on baseline monitoring, the provision of at least eighteen months from the announcement of a scheme to the commencement of rehabilitation should be considered for any future similar schemes, in order to allow sufficient time for requirements around the Appropriate Assessment process. As a public authority Bord na Mona has engaged in Appropriate Assessment screening firstly and then ministerial consultation in respect of scheme activities which are deemed following screening, to require Appropriate Assessment under the Habitats Directive. This necessitated the commissioning of further relevant documentation (i.e. Natura Impact Statements) to facilitate said ministerial consultation and Appropriate Assessment. Changes to Irish regulations over the lifetime to date of EDRRS has also instigated a further requirement for public consultation in instances where a Natura Impact Statement has been produced. Sufficient time should be in place prior to scheme commencement to allow for screening then commissioning of further documentation, followed by ministerial consultation, public consultation, and finally the appropriate assessment determination process.

6.1.6 Supply Chain Issues

Due to external global events including the Covid pandemic and the Ukraine war, the lead in time for delivery of equipment was far longer than originally anticipated. This was particularly the case for the carbon flux tower equipment. Such supply chain delays will be considered and built into the programme for any future purchase and installation of materials or equipment.

6.1.7 Delay in Benefits

Following the completion of the majority of the Year 1 rehabilitation, it has become more evident that while the bogs do appear to have re-wetted, the scientific evidence for this will take some time. Fluctuations due to weather conditions will be more evident immediately after rehabilitation measures are completed and it will take some time for the bog conditions to stabilise. Monitoring

results over a period of time will be required to determine the success of the scheme. This will vary depending on the parameter considered but is likely to be a number of years.

6.2 Initial observations on EDRRS Monitoring to date

Significant time and resources have been inputted into the monitoring of the Year 1 EDRRS bogs and the data collected will be very useful in verifying the benefits of the scheme. While these benefits and their verification will take time to determine, the data collected on an annual basis can be used to assess the trajectory of each bog in terms of hydrogeology, carbon emissions, biodiversity benefits and surface water quality.

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