

Abbeyleix Bog
Conservation Management Plan 2015 - 2020



An Chomhairle Oidhreachta
The Heritage Council



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Conservation Management Plan 2015 - 2020

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**With the assistance of Abbeyleix Bog Project Ltd & its Technical
Advisory Group**

&

Consultative input from interested parties

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Executive Summary

Abbeyleix Bog is a special area that is now held on a long term lease from Bord na Móna by Abbeyleix Bog Project Ltd on behalf of the local community. The site is utilised on a daily basis by walkers and nature enthusiasts. Its appeal lies in the diversity of habitats and consequently species that are known from the site - a considerable wildlife refuge on the edge of a busy rural town. Commercial development of the bog never extended beyond preliminary drainage of the high bog. Currently there are no nature designations pertaining to the site although this will likely change in the near future.

Tim Ryle was commissioned by Abbeyleix Bog Project Ltd to prepare a Conservation Management Plan for the site. Previously, three principal management objectives had been identified by the projects' advisory committee, from which arise with a considerable number of secondary objectives, many interrelated but not all specifically concerned with the actual conservation of habitats and wildlife, but rather the effective and practical management towards achieving the overall objectives.

Best practice guidance, where applicable, has been the guiding principle in preparing the plan. However, the recommendations are mindful of the practical and financial requirements of this voluntary operation community group. It is hoped that the recommendations will guide the community-run project in realising the potential of the site in such a manner as will ultimately benefit their conservation goals whilst enabling the development of the amenity and educational resource.

Acknowledgements

The production of this Plan could not have been carried out without the backing and indeed significant supply of information from members of the Abbeyleix Bog Project. In this regard special thanks are due to Mr Chris Uys and Dr Mark McCorry, as well as the project intern Dr Emma Seale.

Thanks are due to all the stakeholders who contributed to this report. The responses and detailed discussion were often enlightening and benefitted the composition of the final report.

All of the photographs used within the report, other than those taken by the author, are acknowledged and greatly appreciated. Permission to include this photographic material was given by ABP Ltd.

Note

The views presented in this document, whilst being cognitive of the contributions of all stakeholders, may not necessarily represent the entire views of Abbeyleix Bog Project Limited nor of individual stakeholders.

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1 INTRODUCTION

Killamuck (Abbeyleix) Bog (Figure 1) hereafter referred to as Abbeyleix Bog is located 1 kilometre south along the N77 Old Dublin-Cork Road from the Heritage town of Abbeyleix in County Laois (Grid Reference 643682, 682409). It is a relatively small raised bog, roughly oval in shape, which likely developed over at unknown small lake contained by a glacial moraine on its eastern side. The lake, no longer exists, but the historical 25inch Ordnance Survey maps does reveal the presence of at least one lake, the Wild Lough. It may not be linked with the development of the bog itself, as the bog would have developed over a far greater time-scale (Feehan & Donovan 1996). In 1865 the bog was bisected by the Kilkenny Junction Railway running to Portlaoise. The line remained in use for approximately a century, closing on January 1st 1963. After a number of decades, Bord na Móna acquired a large part of the bog with the intention of bringing it into commercial production. A considerable network of drains were installed despite local opposition. After several years and a number of legal challenges the work was halted.

1.1 Background to the need for a Management Plan

The unique character of Abbeyleix Bog, distinguishing it from all other midland bogs is not specifically the combination of its flora, water and peat that have developed over many centuries, but the historical management which when overlain upon the site reflects an ecosystem of exceptional diversity and interest to many, unparalleled in its value in the area.

In the early stages of the project it was recognised that there was a need for remedial works to safeguard the bog and surrounding landscape against the ongoing impacts of natural erosion and degradation (MacGowan 2013). But the site offers so much more to the local community of Abbeyleix. Using a community-based natural resource management approach, ambitious goals were set to consolidate the benefits to the local community in terms of recreation, education and potentially income while retaining the wildlife potential. The stimulus for the development of the CMP arose as a result of Abbeyleix Bog Project Ltd (ABP) Ltd having secured a 50 year lease for the site from Bord na Móna in 2012.



Figure 1: Aerial view of Abbeyleix Bog with area under lease outlined in red. Main access point is at northern tip of site adjacent to the Manor Hotel carpark (Source: Mark McCorry, Bord na Móna)

1.2 Site Ownership & Brief History of its Management

Historically the site formed part of the wider Abbeyleix Estate which the then landlord, the Viscount De Vesci developed. The periphery of Abbeyleix bog itself, as indicated on historic OSi maps, was given over to forestry plantation with some low lying, marshy ground. The remainder of the site was a raised bog and turbary rights were granted to locals by Lord de Vesci. Domestic harvesting of peat continued until the late 1960's, if not some time into the 1970's (Lord de Vesci, pers. comm.).

Bord na Móna (BnM) acquired a large section of the bog in the early 1980's with the intention of developing it commercially for horticultural growing media. Preparatory works did not commence for a few years with the installation of a considerable drainage network. These works eventually ceased in the early 2000's after local opposition from Abbeyleix Residents for Environment Action (AREA). It was considered that it "would have effectively meant the loss of a treasured amenity for the community, not to mention the impact on the biodiversity of the area" (Kearney Consultants 2012).

A reassessment of the site by Bord na Móna in the 2000's resulted in its reclassification as a Biodiversity Area, although it was not selected for designation as a potential National Heritage Area by National Parks and Wildlife Service (NPWS), due in large part to the damage caused by the drainage works (Derwin *et al.* 2002). Thereafter BnM, recognising its intrinsic value as a nature and biodiversity reserve, commenced restoration works on the high bog part funded in cooperation with the NPWS. Restoration works in 2009 saw approximately 30 kilometres of drains being blocked on the high bog to maintain and enhance the quality of the active raised bog habitat. Indeed so successful has been the initial results arising from this methodology, that it has since been used successfully by BnM as part of the company's wider bog restoration programme at a number of other sites other sites (Anon 2014).

After several years, the voluntary Abbeyleix Bog Committee, which stemmed from the Abbeyleix Residents for Environment Action grouping, formed a limited company and set about securing a 50 year lease for the site from BnM. This was on the proviso that the ABP Ltd objectives were to positively enhance the conservation and education value of the site while retaining and improving upon the existing amenity value. The committee have been assisted in this regard by its Technical Advisory Group (TAG) comprising representatives from NPWS; Laois County Council; BnM and the Irish Peatland

Conservation Council (IPCC) together with local community representatives with relevant professional expertise.



Photograph 1: Last goods train passing through Abbeyleix Bog circa 1962. (Source: ABP Ltd archives).

1.3 Site designations – Local and National

Unlike the majority of the County Laois, Abbeyleix Bog is considered to be of considerable environmental sensitivity (County Development Plan 2011-2017). Despite its obvious richness in diversity, its potential as nature reserve within the county has thus far been overlooked.

Abbeyleix Bog receives some mention in the 2011-2017 Laois County Development Plan, with references occurring under chapter 7 Economic Development; and Chapter 13 Amenity Views and Prospects. Indeed Section 13.8.1 specifically characterises the value of the site as a partnership between many agencies and the enthusiastic members of the local community. Two broad policies relating to peatlands, have been transcribed into the development plan.

- NH 13/P26 – Support the identification of projects that have the potential to achieve commercial value such as industrial developments, wind energy, tourism

developments etc. while at the same time promoting high environmental standards and supporting biodiversity objectives.

- NH 13/P27 – Support the restoration of peatlands on suitable sites

In the context of the County Heritage Plan, engagement with Abbeyleix Bog Project and its members' objectives is positively actioned (C. Casey Heritage Officer, pers. comm.). In practical terms, the Heritage Officer has made a definite contribution to the Abbeyleix Bog Project through their support of the Bioblitz event, their involvement on the TAG committee and more recently through the funding of an intern role dedicated to assisting with and furthering the objectives of ABP Ltd.

In a National context, Abbeyleix Bog was discounted as a potential Natural Heritage Area during an earlier review of candidate bogs in Ireland (Derwin *et al.* 2002). The perception at that stage was that the site was of limited ecological value due to its relatively small size (~470 acres) and the fact that the bog had been drained. The survey of scientific areas of interest in Laois by An Foras Forbarta also did not mention the bog, although several other raised bogs in Laois were noted (Farrell 1972). However, a recent review of raised bog Natural Heritage Area Network (Anon 2014b) as part of the wider development of the draft National Peatlands Strategy (Anon 2104c) has recently been completed. Abbeyleix Bog was included in this assessment. The review was tasked with reassessing how the NHA network could contribute towards the National conservation target of restoring Active Raised Bog to favourable conservation status. Alongside this assessment was the concurrent need to avoid unnecessary impacts where possible on the traditional rights of turf cutters and any monetary compensation that might be expected. The ecological value of Abbeyleix Bog has been somewhat revised in the recent past with features such as the Lagg zone being recognised as of having significant value, and various criteria for assessment of the conservation value at a national level have been modified (to take account of smaller sites for example). Restoration work and the current management of the site for conservation by the local community (and the absence of domestic turf cutting) has also been an important factor for its inclusion in the recent NHA review.

Using an internationally-validated approach which looked at Environmental standing, restoration potential, socially appropriate and economically prudent relative to its extent

of sites, 25 additional undesigned sites have been potentially identified for inclusion as Natural Heritage Areas. While the Minister will not reveal the identities until late in 2014, Abbeyleix Bog, which scored an aggregate score of 600+, is likely to be proposed for designation as an NHA (Anon 2014b).

Thereafter, there will be statutory obligation to develop site-specific conservation objectives for each NHA, as these will be used as a basis for restoration planning. Any future designation is likely to include the current area of bog leased to Abbeyleix Bog Project, and may also include additional marginal land. (The recommendations of this conservation management document specifically relate to the lands leased by Abbeyleix Bog Project Ltd.). The site specific objectives for the any NHA designation, which will be subject to environmental assessment are likely to be set during 2015 – 2016 with publication due in 2017. At such stage additional conservation plan targets specifically targeted at achieving national conservation objectives for Active Raised Bog Habitat would be developed. In practical terms this may result in further assistance from NPWS towards the carrying out some of the more costly management objectives which may include a selection of site specific attributes (Figure 2) (RPS Consultants 2014).

2 CONSERVATION MANAGEMENT PLAN

Abbeyleix Bog is a partially drained raised bog that has undergone some rehabilitation. The purpose of the Abbeyleix Bog conservation management plan 2015-2020 is to provide an understanding and establish a framework for which the local community, under the guidance of the ABP Ltd, can practically manage and further develop the resource. It stands to reason that the plan must be practical, given that resources are scarce. The manpower that will be required to carry out the proposed management objectives is drawn largely from volunteers. In addition, the financial wherewithal required to carry out most of the objectives is limited and will require continued dedication from the committee in sourcing the additional funding.

Selection of Appropriate attributes for Site Specific Conservation Objectives

Source: Raised Bog Conservation Project: RPS and NPWS 2014

Patrick Crushell

Attribute	Notes
Area	habitat area of active raised bog present on the site including area currently active and the potential restorable area
National Range	Habitat distribution on site in the context of the range of occurrence of this habitat in Ireland
Supporting high Bog Habitat	What area of the site is high bog
Hydrological Regime	Water levels: extent to which they are within 10cm of the bog surface and the duration for which they are at this level throughout the year.
	Flow Patterns: of water across the site which is related to slope
Transitional areas	Transitional areas between high bog and adjacent mineral soils
Vegetation Quality	Central ecotope on site target to be 50% of total active raised bog, active flush, soaks
Microtopographical features	Hummocks, lawns, hollows, pools
Cover of bog moss species	Cover of peat forming Sphagnum mosses particularly <i>S. fuscum</i> , <i>S. austini</i> , <i>S. capillifolium</i> , <i>S. papillosum</i> , <i>S. magellanicum</i>
Vegetation quality	presence of typical flora and any species of note
Elements of local distinctiveness	present of soaks, flushes, lagsgs etc
Negative physical indicators	peat slope, hardness
Vegetation composition	negative indicator species eg invasive species, spread of trees etc
Fauna	typical and notable fauna and birds
Air quality	nitrogen deposition
Water quality	water quality indicators
Peat Quality	

Figure 2: Selection of site specific conservation objectives that might pertain to Abbeyleix Bog upon designation.

There is a wealth of information about the ecology of Abbeyleix Bog (detailed elsewhere in the plan). It is not the intention of this plan to reproduce all of this data, particularly as some of the data is incomplete, unconfirmed or out of date. The main objective of the

CMP is to summarize key data, particularly current status of habitats and species of in terms of management, conservation importance and to outline specific studies and works to manage these issues.

There is a statutory obligation in conservation plans drawn up by the National Parks and Wildlife Service (NPWS) for designated sites to focus on maintaining/restoring the favourable conservation condition of the designated habitats and/or species. This CMP is not solely about promoting guidelines for the protection and enhancement of the wildlife and habitat diversity. It goes further in that it addresses issues such as maintenance schedules, the provision of access, establishing the site as an educational resource, and furthering the sites integration in the wider local community management e.g. Tidy towns, tourism etc.

The main strategic objectives of the project and the conservation management plan are as follows:

1. The restoration and subsequent conservation of the existing Annex I habitats on the site, as well as maximising the conservation and biodiversity value of the other habitats (e.g. Grassy verges, wet carr), and species of particular ecological value with due regard to the conservation objectives of the National Parks and Wildlife Service (NPWS) in terms of Annex I habitats;
2. The development the site's potential as a centre for environmental research and education on all levels;
3. Maximising the community involvement in developing the site's potential as a recreational, environmental and social amenity.

A considerable number of secondary objectives arise from the three primary objectives, many of which overlap. It should be noted that some of the objectives do not relate directly to the conservation management of the site, but their inclusion in the CMP is implicit as outlined in the tender briefing documents. In some cases where these objectives are likely to require specialist advice, there is a recommendation for additional consultation with appropriate expertise prior to any continuation of that particular aspect.



Photograph 2: Section of the finished Boardwalk across high bog (Source Chris Uys)

3 METHODOLOGY

Abbeyleix Bog Project Ltd have over the course of a number of years developed the rationale behind developing Abbeyleix Bog as a key resource for the community. They have been assisted by the TAG in highlighting the issues that were to be addressed in the CMP. A 'brief for consultants' document outlining the considerable requirements proposed for inclusion in the CMP was developed and issued to Consultants in early 2014. Responses and costings were sought from interested parties. Upon awarding the contract, the brief was discussed at an initial meeting held in March 2014 between members of Abbeyleix Bog Project Ltd. and the author.

It was agreed that given the timescale of the project and the numerous requirements to be dealt with in the CMP, that some would not be fully developed in this iteration of the plan. Rather, recommendations would be made which might guide the project group and their intern Dr Emma Seale along a path to potentially finalising outstanding issues.

The Project has amassed a wealth of information relating to all aspects of the site and also have on-board considerable expertise across a range of areas. However, not all of the knowledge is documented and given the intended input of the wider community, a comprehensive consultation process was initiated.

3.1 Fieldwork

Some limited fieldwork was carried out to identify/clarify a number of outstanding issues, highlighted during preliminary meetings such as the mapping of drains in cutover or under the railway embankment, recording outliers of invasive Rhododendron etc. However, boundary delineations, unravelling intricate vegetation mosaics, confirmation of the presence of smaller habitats or monitoring of habitat condition was not carried out. A GeoExplorer handheld GPS minicomputer (Trimble GeoXT) was used for recording features in the field. The data, which was submitted to Dr Mark McCorry on behalf of Abbeyleix Bog Project, was downloaded onto a computer and imported into GIS software to allow digital mapping.

3.2 Stakeholder Consultation

During the course of preparing the Conservation Management Plan, a consultation process was instigated which consisted of meetings with the project's Technical Advisory Group (TAG); a public consultation meeting in Heritage House in Abbeyleix on April 8th as well as direct contact with numerous stakeholders local or otherwise as expertise deemed necessary. A list of stakeholders consulted during the preparation of the CMP is presented in Appendix 1. I am indebted to all who responded and discussed their views during the preparation of the CMP. It is their contribution that has moulded the plan and the recommendations that are suggested to Abbeyleix Bog Project Ltd.

3.3 Preparation of the Plan – Outputs.

The CMP summarises all of the gathered information and much of relevant information to describe Abbeyleix Bog and includes the contributions of the stakeholders. The main management issues were described and practical recommendations for dealing with these issues are also outlined. For ease of location, all of the various recommendations are also presented together in section 7. Photographs are included to give the reader some sense of the site and its issues, while digitised maps have been kindly prepared by Dr Mark McCorry for inclusion in the report. The official launch date for the plan is late summer 2014.



Photograph 2: Enthusiastic visitors to Abbeyleix Bog learning about its various habitats (Source ABP Ltd Archive).

4 THE HABITATS OF ABBEYLEIX BOG

Of the 190ha (470acres) acres that have been leased, the high bog accounts for only 99.4ha (NHA review) which is relatively small in comparison to many other midland raised bogs, given that it was hemmed in by eskers of the glacial landscape. With no known palynological (peat core) data relating to Abbeyleix Bog, it might be inferred from other raised bogs (Feehan & Donovan 1996) that after the last ice age, approximately 9000 years BP, that the low-lying landscape was characterised by a series of flooded depressions or open lakes. Over time reedswamps developed followed by the gradual colonisation of Fen vegetation. The vegetation is largely alkaline in nature, fed by minerotrophic underground and surface waters. The fen would have experienced relatively high rainfall and low temperatures leading to water logged soils. Over time, peat began accumulating as the cycle of growth and partial decay due to anaerobic soil conditions continued. The transition from fen vegetation to raised bog occurred about 7000 years BP, when the vegetation outgrew the boundaries of the flooded depressions and its roots were no longer in contact with nutrient enriched waters.

By now the convex shape of the bog had started to mould the landscape. The convex shape is generally higher in the centre than at the margins. Raised bogs have a low nutrient content as distinct from the fens that underlie them. Consequently there is a considerable change in the ombrotrophic (rain-fed nutrients) habitat.

The plant communities on bogs are highly adapted to the difficult conditions in an effort to source nutrients whilst retaining water. Adaptations include: A) Xeromorphic or small and waxy or rolled leaves to reduce water loss e.g. Heathers, B) Tussock forming plants to raise above wet ground e.g. Grasses, C) Symbiosis between separate organisms e.g. Lichens and D) Carnivorous plants e.g. Sundews. Thus the typical and often distinctive species assemblage comprising Heathers, Grasses, Sedges, Lichens, Carnivorous plants and Mosses, in particular *Sphagnum* became established at Abbeyleix Bog.

More recently, Abbeyleix Bog has been shaped through human intervention (remnant embankment of the old Portlaoise–Kilkenny railway which divided the site) and management (turf cutting, tree planting) and is now an important wildlife refuge.

The ecology of Abbeyleix Bog (or specific parts) has been well documented over the past number of years. In the context of the CMP, a synopsis of the habitats and the overall

mosaic is presented. The reader is directed in particular towards the following reports which provide the bulk of the habitat information presented in this report.

- Ecological survey of habitats of the Abbeyleix Bog. (MacGowan 2001)
- Ecological assessment and alternative (Bog restoration) Management Plan. (McMillan 2002)
- Killamuck Bog (Abbeyleix, Co. Laois) High Bog Ecological Survey. Ecologic Environmental and Ecological Consultants Ltd 2009)

Common plant names are used throughout the text. Appendix 2 lists the scientific and common names, as well as an indication, where documented, of the various habitats in which these species occur.

Abbeyleix Bog supports a number of semi-natural and modified habitats (Figure 3). By far the largest component is raised bog. But despite the many kilometres of blocked drains now covering the high bog, the majority of the high bog has been classified as degraded raised bog (Annex I habitat) with only a small area of active raised bog (Annex I habitat) (Ecologic Ltd. 2009). Estimates from the NHA review suggest 99.4ha of high bog, 1.1ha of active bog and 4.6ha after restoration of potential active bog. The high bog is surrounded by cutover bog, in which a myriad of different habitats have also developed. They include mixed woodland assemblages and peripheral conifer plantation, much of which was originally planted during the formation of Abbeyleix Estate. In places, the woodland is naturally regenerating naturally or at the least, self-seeding across the bog. Along the western boundary of the cutover, there is there is some naturally developing bog woodland (potential Annex I habitat) dominated by Scot's Pine. Elsewhere within the cutover, scrub and other semi-natural woodland types (bog and wet woodland) are present. Of considerable ecological value is the presence of an intact lagg (comprising fen carr along with a number of other transitional wet woodland types) along the eastern margins of the bog. These transitional zones around raised bogs are extremely rare in Ireland (3 intact sites), having generally been destroyed by peat-cutting (J. Ryan. pers. comm.).

Other habitats include: semi-natural or managed grasslands; small depositing or lowland rivers (more accurately streams); ditches, the majority comprising man-made drains; Built & disturbed ground including the Railway embankment, bare/exposed mud, earthen

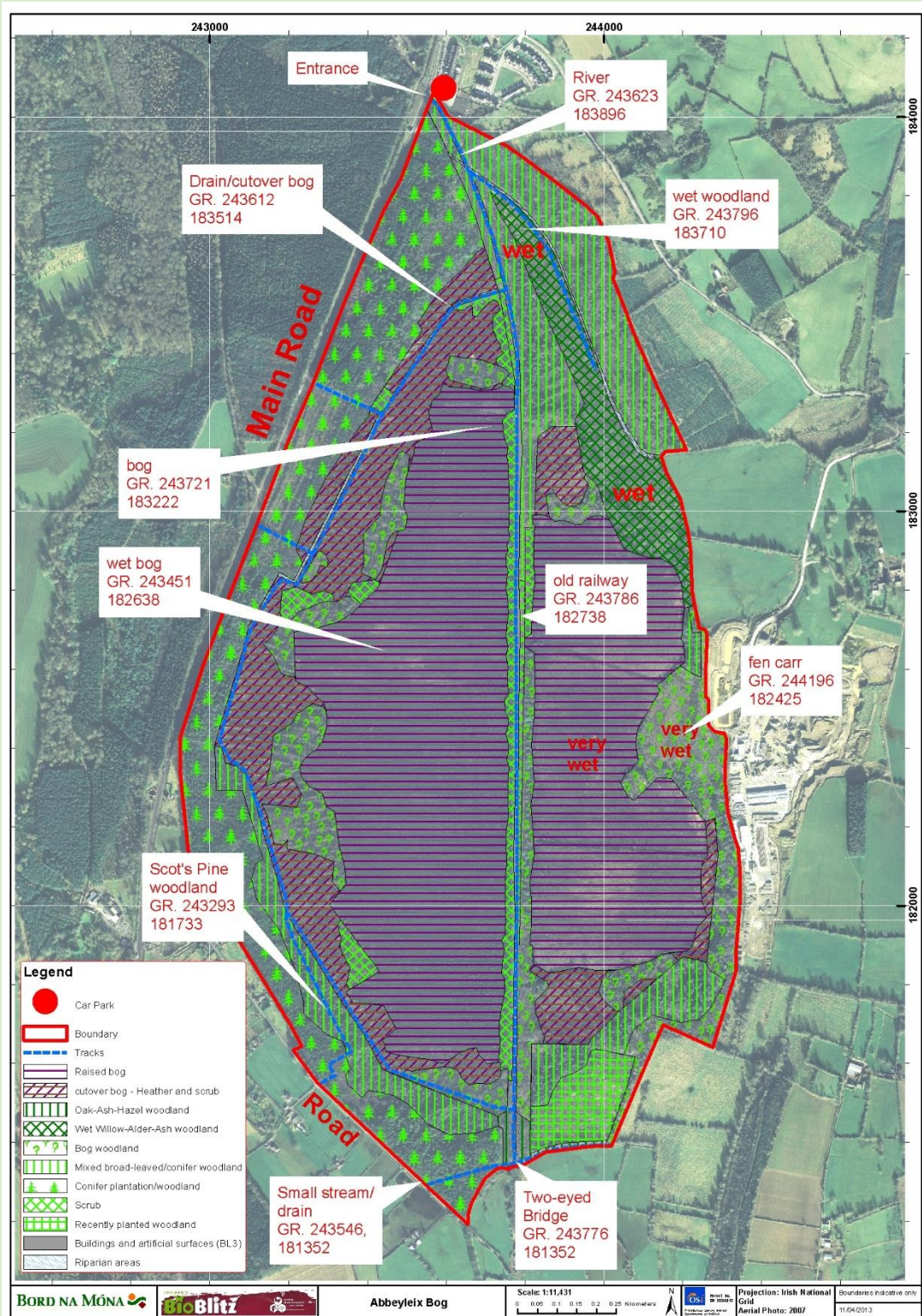


Figure 3: Indicative Habitat Map giving some indication as to the complex vegetation mosaic that is found at Abbeyleix Bog (Source Mark McCorry, Bord na Móna)

banks and old stonework as well as some small or linear grassland and freshwater communities.

Though currently undesignated, there are elements of the above broad habitat categories that correspond with Annex I habitats of the European Habitats Directive (92/43EEC) recorded from the site. The Annex I analogues are largely associated with the Bog e.g. namely Active Raised Bog (7110), Degraded Raised Bog (7120) and Depressions on peat substrates of the Rhynchosporion (7150) as well as potential Bog Woodland (91DO), whose presence has only recently been confirmed from the site (J. Ryan pers. comm.) and certainly warrants further characterisation.

4.1 Raised Bog

Raised bogs develop in shallow depressions or water bodies but over time have infilled through annual cycle of vegetation growth and decay. The anoxic conditions lead to the retardation of the decomposition of the vegetation resulting in the infilling of the depressions and the gradual development of the distinctive domed peatland. The conditions are such that specialised vegetation assemblages develop to counteract the extremes of wet, acid, nutrient deficient habitat.

Prior to any human intervention, all of the Abbeyleix Bog might have been classified as *Raised Bog PB1* (Fossit 2000) but over the ages it has been modified through extensive domestic peat cutting, peripheral afforestation and more recently, preparation for commercial peat harvesting.

The High Bog vegetation at Abbeyleix was recently comprehensively described (Ecologic Ltd 2009). The majority of the raised bog was classified as degraded with only a relatively small area ~1.2ha of actively generating peat habitat known. The vegetation was divided into a number of community complexes or ecotopes, which are described based on the dominant species. Figure 4 presents a diagrammatic representation of the ecotopes that are occur at a typical raised bog.

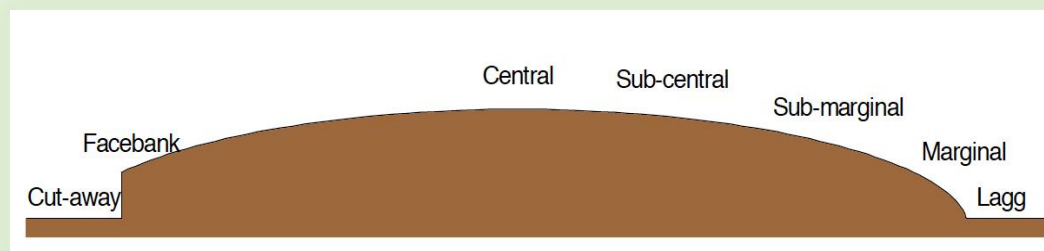


Figure 4: Diagrammatic cross section through an idealised raised bog showing the position of the various ecotopes described in the text (Source IPCC). Note that the term cutaway refers to industrial bogs whilst cutover is used for domestically cut areas such as Abbeyleix Bog.

Within the context of EU Habitats Directive, raised bogs that are still capable of forming peat are classified as *Active Raised Bog (7110)*. This is a priority habitat which accounts for approximately 1% of the high bog (Ecologic Ltd 2009) and it is found in the wettest sections of the high bog. Typically, the habitat is characterised by a complex micro-topography comprising hummocks and hollows. A prominent feature of the habitat is the abundance of *Sphagnum* mosses which is considered necessary for the persistence of the bog and generation of new peat. Other common plant species include distinctive Cottongrasses, carnivorous Sundews and the heathers, Ling and Cross-Leaved Heath. Other notable species include Cranberry, Bog Rosemary and the Great or English Sundew, the final species an indicator of good quality raised bog habitat.

The Sub central ecotope is typified by lawns and accounts for a large portion of the raised bog. The bog surface typically ranges from soft to hard and may be quaking. While lawns typically dominate, occasional topographical differences (Hummocks and Hollows) are observed as well as small pools. The potential expansion, albeit gradual, of this habitat would appear favourable given the drain blocking that was carried out at the site.

The bulk of the high bog, approximately 107.9 ha or 99% of the Abbeyleix bog comprises damaged bog surface, corresponding with the Annex I *Degraded Raised Bog 7120* habitat. Some of it, at least, is considered to have the potential or is still capable of natural regeneration (within a reasonable time frame). The habitat is drier in character than *Active Raised Bog 7110*, having undergone considerable damaging changes to its hydrological status through drainage etc. It is characterised by a greater cover of heathers Ling & Cross Leaved and Deergass. Unlike active raised bog, *Sphagnum* mosses are much less frequent which is not surprising given the lowered water table.



Photograph 4: View of wettest section of raised bog in the eastern part of the site. In the distance, the development of the trees within the main lagg area with the quarry beyond that further.

In terms of ecotopes, the degraded habitat is further broken down into sub-marginal, marginal and face-bank ecotopes. The face-bank ecotope is characterised by the absence of hummock/hollow topography, occurring as it does on level ground. The vegetation is overwhelmingly dominated by tall scrubby Ling Heather. Typically recorded alongside blocked drains, this ecotope can expand into the central sections of the High Bog where drainage has affected the peat substrate.

The marginal ecotope is slightly wetter than the face-bank ecotope. It is characterised by lower vegetation growth (particularly lower heather growth). It covers large sections of High Bog on the western lobe and surrounds the sub-marginal ecotope on the eastern lobe of the bog. A large section of the western lobe consists of an intricate mosaic of marginal/sub-marginal ecotopes, with the latter forming long strips of vegetation between drains. Micro-topography consists of low hummocks, flats and very occasionally hollows. *Sphagnum* cover is generally lower than 10%.

At Abbeyleix, the sub-marginal ecotope covers large sections of the eastern lobe where its surface ranges from hard to soft and is not as wet as the bog proper. There is a greater

development of hummocks and hollows than the marginal ecotope, which are characterised by a greater cover of mixed *Sphagnum* mosses as well as Bog Cotton, Deergrass, Reindeer Lichen and Ling on hummocks and Bog Asphodel in hollows.

Into the mix, a final Annex I habitat, which can occur across a number of ecotopes, namely *Depressions on peat substrates of the Rhynchosporion (7150)*, is patchily distributed across the High Bog in hollows and other wet areas such as at the margins of pools or *Sphagnum*-dominated lawns. It is rarely extensive. It is also known as a pioneer community in disturbed areas such as peat cuttings. At Abbeyleix, the habitat consists of open vegetation largely characterised by an abundance of White beak-sedge as well as a handful of others such as *Sphagnum* mosses, Cottongrass and insectivorous Sundews.

It is not uncommon to observe Scots Pine and Downy Birch scattered across the entire High Bog, which are largely self-seeded. Trees are often indicative of the deteriorating hydrological conditions required for the proper functioning of the bog. Elsewhere patches of wet woodland dominated by Birch are known from on the east of the High bog. As this area was not previously cut in the past, there is a natural gradation from bog to wet woodland.

Recommendations

- Repeat the ecotope survey of the High bog, every 5-10 years to gauge the efficacy of restoration policy and ascertain the extent of potential (favourable) habitat gain
- Prioritise areas of high bog where tree and scrub colonisation are impacting habitat & instigate plan for their removal
- Finalise the hydrological restoration plan and prioritise the areas identified in Map 4, Appendix 3 which would benefit from additional management

4.2 Cutover Bog

Classified separately from raised bog, as it describes areas that have historically been cut for domestic peat, this habitat is classified as *Cutover Bog PB4* (Fossitt 2000). It is found around the edges of the raised bog and is often exemplified by bare ground or regenerating vegetation cover as a result of former peat harvesting. The habitat covers near vertical peat faces, but it can extend a considerable horizontal distance away from the raised bog depending on the extent of cutting. Much of the interest in this habitat at

Abbeyleix stems from the fact that there is considerable structural and hydrological variety which has benefitted the development of many other habitats, some of considerable ecological interest.

And like intact bog, parts of the cutover bog, can under suitable conditions may have links with the Annex I *Depressions on peat substrates of the Rhynchosporion (7150)* habitat, although in the absence of further survey, its extent at Abbeyleix is currently unknown.

In general terms, while the floristic composition of the cutover can be variable, a constant species is Ling, which is unsurprising given that cutover is usually much drier than the raised bog. The presence of other species is controlled by factors such as topography, drains or pools, depth of remaining peat etc. Thus the species list associated with the cutover at Abbeyleix is both varied and considerable and there is considerable overlap with many of the following habitat descriptions.

It is now recognised that peat-forming plant communities as well as secondary lagg can develop on cutover. Wetter areas and pools with a surfeit of *Sphagnum cuspidatum* are often indicative of potential new peat forming areas. There was some visual evidence of potential regeneration within parts of the cutover, most notably along the northern section of both western and eastern lobes (Ecologic Ltd 2009). *Sphagnum* lawns infill drains in these sections and in the eastern lobe they appeared to spill over onto the cutover. Several locations were identified, during fieldwork as part of the CMP preparation, with large concentrations of *Sphagnum* in drains. These are likely to figure in future restoration works at the site.

A number of other lesser habitats have become established within parts of the cutover. There are elements of *Dry Heath HH1* vegetation throughout the cutover mosaic with some of the better examples found adjacent to the cutface of the bog along its Western edge. Although often occurring in close proximity with the raised bog, this occurrence of this habitat is indicative of situations where the underlying soil conditions are very dry or at least freely draining. Typically dominated by Ling, other components of the habitat include Cross-leaved Heather, Bilberry and Tormentil as well as occasional Bracken.

Although not widespread, the presence of vegetation dominated by Bracken is classified as *Dense Bracken HD1* habitat. Unlike the typical habitat described in Fossit (2000), it is a minor constituent at Abbeyleix in that most of it is patchily distributed on drier cutover

areas where Rhododendron and scrub are present or as part of the Pine Woodland understorey rather than as extensive stands in open ground.

Recommendations

- Finalise the hydrological restoration plan and identify areas of cutover which would potentially increase the restoration possibilities for regenerating raised bog habitat. benefit from additional management
- Survey cutover to establish baseline condition and character of mosaic communities prior to any rewetting

4.3 Lagg

Lagg Fens are transitional zones around raised bogs where seepage of surface waters from the peat body meets mineral soils. In addition, they are fed by mineral rich groundwater. They may be precursor vegetation to bog, or as is most likely for most parts, secondary in nature having established on cutover where the vegetation is in contact with mineral influences of underlying glacial soils or upwelling groundwater.

The presence of an intact lagg along the eastern side of the bog is a very significant feature of this site. This transitional zone is an extremely rare in Ireland with only 3 intact sites including Aghnaguig in Cavan, as they have largely been destroyed around the country by peat cutting. The alkaline vegetation is classified as *Poor Fen and Flush PF2*, a habitat that is limited in its distribution throughout Ireland (Fossett 2000), and is associated with natural drainage features on raised bogs and intact lags.

The lagg at Abbeyleix Bog is partially wooded and can be classified as 'Fen Carr'. Fen Carr often consists of an ill-defined group of wooded wetland habitats. The intricacies of the habitat or its mosaic represents a number of similar or allied vegetation types. All occur on marshy, often waterlogged soils that have developed over long periods on lake basins. Fen carr and its various components can represent an integral part of the early stages in the formation of a raised bog habitat.

Characterised by a reputed rich floral diversity of over 120 plant species (MacMillan 2002), the ground flora is characterised by the Greater Tussock Sedge along with a number of smaller sedges as well as rushes, and locally distributed herbaceous species

such as Marsh bedstraw, Bogbean, Tormentil and interestingly, stunted Holly. Mosses may be locally abundant but rarely carpet this wet habitat.



Photograph 5: Waterlogged Carr woodland at Abbeyleix (Source Chris Uys)

Three areas of Carr are recognised. The first is situated to the north of the site flanking the main entrance. In places it supports wet Ash woodland but as the ground gets wetter to the south, this grades into true Carr vegetation, which has the most extensive area of primary Carr development. Tree species are largely dominated by Willow and Birch whilst the understorey flora in wet areas is characterised by swathes of Tussock grass or

Greater Tussock sedge while other common wetland plants include Yellow Flag, Purple loosestrife, Meadowsweet and Bogbean.

And while woodland species are an interesting feature within the lagg mosaic, some of the wet woodland at Abbeyleix Bog occurs in cutover, and as such cannot be considered as true lagg, secondary or otherwise.

There are complex hydrological interactions, not as yet fully understood at Abbeyleix, that occur between the wetland habitats and bog woodlands and surrounding cutover bog, hence the persistence of this important alkaline vegetation is intimately linked to the conservation of the hydrological processes in the surrounding the area. Anecdotally, some consider that there has been a contraction in the extent and quality of parts of this area over the past number of years. There is no quantifiable data to confirm this, but it could be that changes in the groundwater status and the influx of silt runoff from the quarry spoil heap may be an issue.

Recommendations

- The intricate mosaic including Annex I habitats would benefit from further survey and delineation of the various habitats therein
- Engage a hydrological expert to consult on the hydrological issues surrounding this issue
- Instigate consultation with Quarry regarding potential for remediation

4.4 Wet Woodlands

Within this category a number of habitats occur, most in close proximity to one another and sometimes with imperceptible gradations between them. The first woodland habitat is *Bog woodland WN7* which occurs on intact bog or fen peat as well as suitable bog margins and cutover. These woodlands, which are rather rare in Ireland, grow in permanently waterlogged soils resulting in the occurrence of a specialised flora and fauna (Anon 2009). Despite this fact, bog woodlands are still not well understood in Ireland and Cross & Lynn (2013) regard that most occur as a result of a single incident, as regeneration is not commonly encountered.

Under EU Habitats Directive, the “distinctive” Bog woodland habitat corresponds with the priority Bog Woodland 91D0 habitat, of which four subtypes are listed in the EU

Interpretation manual (Anon 2007). Of those four sub-types which, only bog woodland dominated by Downy Birch and a number of *Sphagnum* moss species is recognised in Ireland.

In their report, Cross & Lynn (2013) characterised the habitat as woodland dominated by birch in the canopy with *Sphagnum* cover greater than 25%. Other typical components of the habitat include Willows, Alder and Rowan with a field layer often comprising Ling Heather and Bilberry as well as epiphytic moss and lichen communities.

The characterisation of the habitat at Abbeyleix is less distinct however, as there is often a transition to other Carr vegetation. The distinction is based upon the presence of species indicative of ground water-influence. The permanently high water table associated with Bog Woodland is naturally poor in nutrients. Based on their sampling carried out in 11 separate sites (not including Abbeyleix,) Cross & Lynn (2013) describe three distinct Irish sub-types according to their location: on raised bogs; on cutaway; within Sessile Oak woodlands.

In the context of Abbeyleix Bog, vegetation assignable to the Annex I habitat is only recognised from around Wild Lough where it occurs in transition with other closely allied woodland habitats and indeed lagg. One species of note, however, recorded from the site by Jim Ryan is the characteristic Fringed Bog Moss (*Sphagnum fimbriatum*). The other bog woodland found around most of the site generally has limited or no *Sphagnum* cover.

Downy Birch is to be abundant across much of the bog, with the highest density of Birch-dominated woodland recorded the eastern and south-eastern sections of the site. Its occurrence, in places alongside the lagg is as a result of ground water influence which is indicated by the presence of carr species, e.g. Ash and Marsh Horsetail.

Spatially allied with Bog Woodland, a number of habitats under the broad riparian woodlands category including possibly *Riparian Woodlands WN5*. Considered to be under threat throughout Europe (Anon 2009), this category of woodland includes wet woodlands that are subject to periodic, usually winter flooding events. At Abbeyleix, it is mainly confined to an area in the North-Eastern part, to the north of the mature Pine woodland.

Owing to the fluctuations on the water levels, the habitat is home to many plant species. The canopy vegetation is dominated by Willows, Downy Birch, Alder, Ash and to a lesser extent Hazel. It rarely reaches heights above 3.5 metres and in places can be quite low with accumulations of dead wood or fallen wood across water-filled ditches. The understorey is characterised by a combination of plants – grasses such as Creeping Bent, Floating Sweet Grass and broadleaved herbs such as Buttercup and Meadowsweet. Other uncommon but locally abundant plants include Butterbur and Wild Angelica.



Photograph 6: Small stream meandering through wet woodland.

A final woodland habitat of wet areas is the *Wet Willow Alder-Ash Woodland WN6* which occurs in a number of places. Readily recognised by the occurrence of the eponymously named species in its title and because ground in which it occurs it is near permanently waterlogged. Like many of the other riparian habitats, the field layer is varied, though frequent occurrences include Creeping Bent, Marsh Bedstraw, Purple Loosestrife and Greater Tussock Sedge.

Recommendations

- Undertake a survey to characterise and map the current boundaries of all of the various woodland habitats, particularly the potential Annex I Bog Woodland

4.5 Other Woodlands

Several other woodland assemblages are known from Abbeyleix. One of the largest and certainly one that most visitors will encounter is semi-natural *Oak-Ash-Hazel* WN2 woodland. It occurs as a linear strip along either side of the railway track and extends into Eastern parts of the Bog. A second area of this woodland is recorded from the south eastern part of the site, although not all is within lands leased by ABP Ltd. The habitat occurs on reasonably well-drained, base-rich soils with distinct mineral soils. Typically dominated by admixtures of Oak, Ash and Hazel, Sycamore is a significant component, particularly in the South eastern part of the site. The field layer can include a considerable number of herbaceous species and ferns, although they can be locally abundant or may signify transitions to other habitats within the overall mosaic.

There is an abundance of planted conifers adjacent to the perimeter of the leased bog, which would be assignable to or (*Mixed*) *Conifer Woodland* WD3 or *Conifer Plantation* WD4 in the case of single species managed plantation forestry. That some are long established is suggested by placenames shown on the Ordnance Surveys 25" Historic Maps such as Ballymullen or Douglas Plantations and were established when the bog was part of the larger Abbeyleix Demesne. The largest plantations are found to the north and west of the site, largely outside the boundary of the area leased by ABP Ltd. These areas are largely characterised by single species or admixtures of non-native trees including Silver Fir, Spruce and Cypress. The understorey is typically poor owing to the shading, but the habitat does in, the context of Abbeyleix Bog, harbour some dubious invasive species including Rhododendron and Cherry Laurel. Both of these species are spreading to differing degrees across the Bog.

There are other areas of coniferous woodland, along the South western part of the site, that are characterised by mature Scots Pine, though in places they may occur mixed with other species. This habitat is assignable to *Mixed Broadleaved/Conifer Woodland* WD2 as Scots Pine may not be the only canopy species. Unlike the coniferous plantation, this habitat is more open and there is a greater development of smaller trees including Holly, Birch and some Rowan. The ground flora is more diverse. Although typically it is dominated by patches of Ling and Bilberry occur with Bracken also recorded in drier areas. The mature woodland has the potential to develop into a habitat of high value.



Photograph 7: Scattered bushes of Rhododendron under Pine canopy at edge of bog. Both of these species are readily colonising Abbeyleix Bog.

Conversely, in the context of Abbeyleix Bog the abundance of Pine seedlings is problematical especially as they continue to encroach across parts of the High Bog. Not all of this woodland was planted and it is clear that natural colonisation is occurring in cutover along parts of the Eastern margin of the site, as well as other peripheral or isolated or as yet unmanaged areas of cutover. Indeed it is in places extensive and to the uninitiated appears that it was planted occurring as it does in regular spaced albeit stunted along the bog surface. This is particularly apparent on the Eastern part of the raised bog stretching from the railway track in the direction of the Quarry.

Recommendations

- Establish a regular monitoring programme for highlight areas where seedling reestablishment occurs
- Look into Native Woodland scheme for funding towards areas of natural regeneration

4.6 Scrub

Locally abundant at Abbeyleix Bog *Scrub WS1* is readily characterised by the dominance enjoyed by shrubs e.g. woody vegetation whose canopy height rarely exceed 4 metres. Trees may often provide an integral element of the scrub as their growth is retarded through nutrient deficiency or waterlogging. Scrub varies in both species composition and in its structural development in that it can be open or dense in nature. Commonly recorded components across the site include Gorse, Birch, Willows and Brambles. Other species that are confined to wooded areas or hedges and verges include Hawthorn, Blackthorn and Hazel. In terms of its wildlife value at Abbeyleix, scrub is an important habitat for passerines and others groupings, but is indicative of drying conditions around the edges of the bog.

A closely allied habitat is that of *Ornamental/Non-native shrub WS3*. This habitat accounts for all scrub (but not woodland understorey) dominated by non-native shrubs, particularly the invasive Rhododendron and to a lesser degree Cherry Laurel as well as species such as Cotoneaster this latter species is largely confined to areas around the main entrance. Of immediate concern in terms of the condition of the site at Abbeyleix is the abundance of Rhododendron. Widely distributed throughout the cutover, where it occurs in drains and derelict areas, this invasive species has in places developed into extensive thickets which will prove laborious to manage (See section. 6.2.1.).

Recommendations

- As the bird nesting season runs from the 1st March to the 31st September, the cutting of trees, bushes and hedgerows should be prohibited during this period.
- To facilitate wildlife resource, the large scale removal of native scrub should not be carried out except where it occurs on high bog and in those areas considered problematic or incompatible with the objectives of other habitats considered of more pressing concern or priority
- The removal of non-native species should be prioritised and appropriately managed See section 6.2

4.7 Grasslands

Unsurprisingly for Abbeyleix bog, the occurrence of grassland habitats is largely confined to either side of the old railway embankment. This is also the area that many of the sites visitors/users pass on their way to the bog. In terms of classification, a number of closely allied habitats are recognised, though they often imperceptibly grade into one another. Notwithstanding this fact, these areas provide an important resource for a plethora of the sites faunal diversity and are home, in places to a number of orchids.

Unlike the largely acidic substrate that account for most of this site, all of the grasslands are unified by their calcareous or neutral nature of the underlying soils. The first habitat *Dry Meadows and Grassy Verges GS2* is best represented by parts of the old railway embankment track and can be quite diverse, though this is often a factor of the mowing regime. There is considerable diversity among the grasses and broadleaved herbs which define this habitat though they are not always equally distributed. Most are relatively tall growing and include any number of plants. A sample list of commonly recorded species includes: Common Knapweed, Nettles, Thistles, Willowherbs, St John's Worts, Buttercup and Daisy, while conspicuous grasses include Yorkshire Fog, Cocksfoot and False Oat Grass, this last species also typical of earthen banks along the old railway embankment.

The *Wet Grassland GS4* community at Abbeyleix is in places species-rich and contains indicators of base-rich soils and waters found around the edges of the raised bog, as understory elements of riparian woodland and also on cutover along parts of the Killamuck bog loop where it intersects with the old railway track. Species composition can vary greatly but common components include grasses such as Tufted Hair-grass, Purple Moor-grass and Creeping Bent along with Yellow-flag, Purple Loosestrife, Marsh Bedstraw, Lesser Spearwort, Common Reed, Meadowsweet, Devils Bit Scabious and Marsh Thistle. It is in a small section of this habitat that the main concentration of orchids from the site are recorded. These include Marsh Orchid, Heath Spotted Orchid and the Fragrant Orchid.

There may be some limited situations whereby this habitat may grade into *Marsh GM1* although it could not be regarded as extensive. This closely allied habitat is characterised by waterlogged soils such as are found in grassy hollows alongside drains in parts of the cutover, but it is not a peat forming habitat. Unlike the previous habitat, grasses are not

the main feature of marshes, rather a diverse range of broadleaved herbs dominate. They include Water Mint, Marsh Pennywort, Marsh Marigold, Meadowsweet and Purple Loosestrife.

Recommendations

- Ensure that any verge maintenance is carried out in sections rather than as single swathe so as to negate disturbance for wildlife
- Discourage the picking of colourful flowers – a) they may be host or food source for butterflies & b) they may be very restricted in their distribution at Abbeyleix Bog e.g. Orchids.

4.8 Water features

Part of the characteristic distribution and extent of the wetland habitats of Abbeyleix Bog is governed by the presence of water. The raised bog and its various niche habitats including the lagg zone is dependent on water for its structural integrity and floristic diversity. All are generally narrow in nature or have been influenced as a result of human management practices. The extensive network of man-made drains across the high bog are included elsewhere as part of the raised bog habitats.

Apart from two small rivers, that are classified as *Depositing/Lowland Rivers FW2* most of the previously altered watercourses are somewhat misleadingly classified as *Drainage Ditches FW4*. All are narrow linear landscape features containing flowing water, although at times the flow may appear stagnant. The small rivers are underlain by fine sediment with occasional patches of deposited stone or other debris - largely fallen trees. Some of the ditches have been modified such as occurs in the cutover in the North Eastern part of the site. Indeed, they flow into a number of deep pools at the abandoned cutface.

In terms of the plant communities, this is influenced by a number of factors outlined in Fossit (2000). It is rare for extensive development of vegetative cover and where it does occur it is often small clumps of single species. Typical examples of species from Abbeyleix Bog site include Yellow Iris, Pondweeds, Water Mint and Water Starworts as well as some marginal plants from adjacent habitats. Occasionally, pools or stagnant sections are dominated by either algal deposits or Feathery Bog moss, although this is more typical of bog drains.

In wetter areas, indeed, where standing water may be present for part of the year other common plants include Greater Tussock-sedge, Floating Sweet-grass, as well as Catstail, Feathery and in pools feathery Bog Moss (*Sphagnum cuspidatum*). Species indicative of nutrient depletion include Rushes. Patches of Birch and Willow are not uncommon growing shallow standing water of smaller drains.

Recommendations

- Ensure that all operations carried out during the management of the site do not alter linkages between the drains and smaller streams within the woodland areas potentially impacting with downstream areas and its wildlife concerns e.g. River Nore SAC
- Commission a survey to map out the course of all watercourses entering or weaving through the site as part of a greater understanding of the hydrological influences on the habitats
- The negative influence of silt-laden water from the Quarry spoil heap on the lagg area should urgently addressed through consultation and the design and implementation of a remediation plan

4.9 Disturbed Ground, Built Land and other minor habitats

This category incorporates a number of habitats, largely of human origin or at least management. They not usually considered of real conservation value but may have merits in the overall mosaic at Abbeyleix Bog and the species that are recorded there.

Areas of bare ground, mud or peat are classified as *Spoil and Bare Ground ED2*. They are patchily represented throughout the site, best represented along trails where bare mud occurs. It is also occasionally noted when ground or aggregate is scraped and piled onto the verges. Pioneer vegetation can over time or as disturbance ceases colonise the bare ground.

Over time, there is often a transition from the previous habitat to *Recolonizing Bare Ground ED3*. This habitat accounts for large parts of disturbed ground on the margins along the old railway embankment trail that divides the site. It is typically characterised by a diverse floral assemblage, mostly pioneer species but may include non-natives or garden escapees. Common occurrences include a varied mixture that are often irregularly occur in suitable areas. The varied list includes Nettle, Willowherbs, Horsetails, Thistles and

Coltsfoot. Other characteristic species include Wild Strawberry, Hemp Agrimony, Weld, Knapweed, Common Birdfoot and Oxe-eye Daisy. These plants are important for wildlife, providing a food/perching source for butterflies.

Ordinarily the category *Stone Walls and Other Stonework BL1* is not recognised by many as a typical habitat, nonetheless it affords potential refuge for certain plant species, lichens or mammals such as bats. Given the nature of the site, there is little evidence of this habitat at Abbeyleix, except for the two-eyed bridge, a remnant of the long abandoned railway.

Often a feature of the Irish landscape, *Earth Banks BL2* are not common at Abbeyleix Bog, except for small stretches of the old railway embankment. The vegetation assemblages reflect elements of a range of adjacent habitats including grassland, heath, bog and scrub and hence the species list can be diverse. Occasionally, such as when verge maintenance occurs, the vegetative cover exposes the peat or gravel-rich substrates used in their construction.

A final manmade habitat, *Buildings and Artificial Surfaces BL3*, is almost negligible in its occurrence at Abbeyleix Bog. There is a remnant block built gate pillar along the trail near the entrance to the site. Unlike the previous category, it is of modern origin and supports mostly moss species.

Recommendations

- The importation of aggregate or clearance of material from the access trail should be stockpiled in appropriate areas so as not to impact with existing vegetation and impact feeding sites for birds, bees and butterflies
- Monitor the spread of bracken in drier areas and manage appropriately where necessary

5 FLORA & FAUNA

Abbeyleix Bog supports a wealth of biodiversity – both flora and fauna largely as a result the juxtaposition of historical and recent management regimes upon the various habitats. A total of 532 plant and animal species were listed in a 2002 study of the site (McMillan 2002). More recently, as part of the 2013 local area Bioblitz competition, the site yielded an impressive tally of approximately 355 plant and animal species. Several new records for both the County and Abbeyleix Bog were made including a number of ecologically

important species. A catalogue of the most recent species known from the site is listed in Appendix 2, with a discussion of outstanding conservation objectives in section 6 (which often overlaps (or indeed repeats) with objectives and recommendations in section 5). Common names are used throughout the text unless none exist. There are obvious gaps in the data and some biota have yet to be studied or enumerated. In presenting the table, the divisions are the authors construct based on the availability of greater information about a particular group rather than its scientific inclusion in a formal grouping. Each grouping is briefly discussed below and recommendations presented.

5.1 Plants

It is apparent to anyone who visits Abbeyleix bog that it is floristically rich. This is unsurprising given the range of habitats that are recorded here as well as the management regime to which the site has been subjected to over the years. This floristic diversity is detailed in a number of separate reports compiled over a number of years that detail the entire site or specific habitats (MacGowan 2001, McMillan 2002, Ecologic Environmental and Ecological Consultants Ltd 2009, and Tubridy and Hickey 2010). The results of the 2013 Bioblitz event at Abbeyleix merely confirmed the diversity of the sites flora. A list of all known species is presented in Appendix 2. As with most things in nature, the list is subject to ongoing change (even during the preparation of the CMP).

In terms of known higher plants, the majority of the records are not uncommon and are known from similar habitats elsewhere in the county and further afield. Plant species worthy of mention include Bird Cherry and an uncommon parasitic plant associated with the roots of ivy, namely Ivy Broomrape. Both of these plants are Red Data Book species (RDB) (Curtis and McGough 1988). Two further species for which early records exist but for which no recent confirmation has been forthcoming include Marsh Fern and Common Wintergreen. Again both are RDB species and if refound, would greatly enhance the sites ecological value within the county.

The distinctive Pitcher Plant (Photograph 8) was introduced into Lisduff Bog in Laois in the 19th century but it is believed to have died out (Foss and O'Connell 1985). A number of specimens of the Pitcher Plant were transplanted from Derrycashel bog in the 1970's (Lord de Vesci, pers. comm., Nelson & De Vesci 1981). Its presence was reconfirmed in 2002 (McMillan) and 2009 (Ecologic Ltd. 2009). These introductions were innocently

done at a time prior to the better understanding regarding the negative impacts of introducing foreign species. The presence of this species alongside *Rhododendron* and Conifers is now considered by the IPCC as one of the main biotic problems facing peatland conservation efforts in Ireland, and certainly should where found be removed from Abbeyleix Bog.



Photograph 8: Introduced pitcher plants (*Sarracenia purpurea*) on Abbeyleix Bog (Source Mark McCorry).

In the wider landscape, the NPWS database covering the 10 kilometre grid square in which the site occurs (S48) lists a single record only from 1898 for Red Hemp Nettle. This historic record lists its occurrence as in the environs of Abbeyleix, most likely an old quarry. It is not known from Abbeyleix Bog and no recent records are known from elsewhere in the county (M. McCorry, pers. comm.).

Bryophytes or Mosses and Liverworts are another group for which there is reasonable data at Abbeyleix. This grouping of simple, small land plants with leaves and stems but lacking roots or a vascular system distinguishes them from flowering plants and trees. Results from the Bioblitz record forty eight moss species and nine liverworts. Some are notable, indeed were new county records. The *Sphagnum* mosses typical of parts of the bog or some wet pools are probably the most easily seen mosses on the bog surface, but they can be difficult to identify despite the varying colours and forms. New Vice-County records, originating from the 2013 Bioblitz include the liverwort, Palmate Germanderwort and the mosses - Slender haircap and Fringed Bog-moss. This last

species, is an often overlooked characteristic species and was recently recorded from the lagg area in the eastern part of the bog.

In terms of practical recommendations; recording and monitoring of the flora is best done through systematic surveys of individual habitats such as the ecotope surveys on the high bog or future statutory monitoring surveys if the site is designated for conservation purposes. In this way comparable records and potential changes can be assessed. That is not to discount casual records, but scientific approach to some key species will enable monitoring of the efficacy of the management effort as well as the health of species and by inference sensitive habitats such as the bog which are characterised by a suite of specialised plants.



Photographs 9 & 10: 9) View of early rhododendron clearance, whereby material is all bunched for a year prior to removal. (Source Chris Uys) 10) Regenerating Rhododendron (May 2014) at site of fire from August 2013.

The removal of Rhododendron is a priority issue for ABP Ltd. and some monitoring of its efficacy in tackling this problem (along with tree, scrub removal on the bog or cutover, should be initiated). This is a considerable problem throughout parts of the bog and one that is important, as the potential for reestablishment from outside the site is ever present. It is beyond the scope of this plan to recommend remotely sensed data to monitor change, given the cost, extent of some habitats and the accuracy within a small scale. Thus along with repeated visits to cleared areas (as recommended in Section 6.2),

the establishment of some monitoring exclosures might be considered. While it might seem obvious that Rhododendron is in an area being tackled, its potential re-emergence is always possible. Their design and siting would require some thought prior to commencement but could form an interesting educational project for an interested school, if not ABP Ltd themselves.

Recommendations

- Monitor management procedures and refine as necessary those that may impact the flora to the (short-term) detriment of other species such as butterflies
- Consider installing exclosures to monitor efficacy of vegetation clearance or to exclude deer
- Be vigilant for arrival of all invasive species, not just Rhododendron, from adjacent landholdings, either by natural vectors or through use of equipment/machinery brought from other sites
- Map orchid-rich areas and monitor for changes due to pedestrian damage or other impacts

5.2 Mammals

There are a number of different mammals groups known from Abbeyleix bog, all of which add to the intrinsic value of this site. As with many Irish mammals, most are nocturnal or at least, elusive during daylight hours, often being wary of humans. The majority of Irish mammal species are wholly protected under the Wildlife Act 1976 as amended 2000. There are a small number of exceptions which are afforded no legal protection - Fox, Rabbit and Rat owing to their widespread distribution; Invasive American Mink which is well established across parts of the country as a result of escapes or uncontrolled release from fur farms; or Fallow deer which are classed as a quarry species within the licensed hunting season.

There are some notable fauna that have been recorded from the site. The majority of records are casual in nature, based on fleeting observances and occasional fortunate photographs. Other substantive evidence is secondary in nature and includes prints, latrines, hair and feeding remains. The current list is shown in Appendix 1, although undoubtedly some species remain undocumented or would benefit from further studies to enumerate population dynamics. Some of the notable mammal occurrences from the site include:

- Badger
- Irish Hare – occasionally seen running across high bog;
- Red Squirrel – a single juvenile has been reported, from cutover area north of the high bog
- Otter- Adult & 2 juveniles seen in stream near one of the information notice-boards in summer 2013
- Pine marten - seen on land adjacent to eastern side of site in 2012
- Fallow Deer is a regular visitor to the area

N.B. There is some confusion as to the veracity of this species occurrence as some consider it to be Red Deer, a species of limited known distribution in Ireland.

Some of the records that are known of, or that may in the future be acquired, are of a sensitive nature and should not be made public. The greatest threat to mammals is often humans. To this end the management of the site should always consider any impacts and try to negate them. This could include issues such as large groups crossing the boardwalk on the high bog, to the removal of long established trees used as nesting or perching sites.

It is clear that documented records of smaller mammals from the site are absent. This knowledge gap could be easily remedied through an educational project with willing partners and expertise such as the local branch of the Irish Wildlife Trust - “Small but meaningful community-led projects are considered to be hugely beneficial and should be encouraged where possible” (R. Whelan. IWT Laois Offaly Branch, pers. comm.).

It could be suggested that that there can never be enough detailed ecological information for a site when carrying out conservation management objectives. Despite the shortcomings in the knowledge of mammals on site, ABP Ltd. and its volunteers should be aware of the potential for negative disturbance to mammals. The removal of excessive tree and scrub vegetation could impact upon corridors, habitation sites and feeding areas. Thus prior to any vegetation removal, a cursory check of the area for signs should be made. Thereafter, phased removal of vegetation should be done, without “clearfelling” an area. Certainly in terms of native tree lines and Scrub/hedgerows, gaps no greater than 30 metres in length should be made. Otherwise, terminating a potentially effective wildlife corridor could be disastrous.

The potential for rewetting parts of the bog would not be seen as a threat to most terrestrial mammals. Those that would likely be impacted include smaller mammals but would likely relocate to suitable terrain. Rewetting should not be considered for dry or wet marginal habitats at the site as these serve as corridors to many terrestrial species.

There is little detailed information on bats species present at Abbeyleix. Two species of Pipistrelle bats, Common and Soprano Pipistrelle were recorded during the 2013 Bioblitz event. A future programme of surveying could potentially reveal the presence of additional species on site. It would certainly enhance the biodiversity value of the site.

Recommendations

- Maintain a database whereby records are easily inputted by all
- Partner with IWT to plan surveys of outstanding knowledge deficits
- Invite a bat group (accompanied by ABP volunteer for local knowledge of terrain) to carry out a bat survey of different areas of the site
- Do not carry out major operations – tree-felling, without determining Potential Bat Roosts or as nesting sites for birds. All operations must be done in the appropriate season (March 1st-August 31st) as dictated by Irish Wildlife legislation

5.3 Birds

The site itself is not dedicated towards bird watching and the majority of the birds recorded from the site are noteworthy only to interested persons rather than scientific benefit of the wider environment. The range of birds from ground-nesting birds of open bog habitats, songbirds and Passerines associated with trees, scrub and hedges. Birds of Prey and Corvids also use marginal habitats such as conifer plantation and edges of the bog.

Whilst there has been some formal recording of bird species from the site, most records are casual in nature and largely the result of many keen individuals. Thus the data relating to birds at Abbeyleix cannot be considered entire. More recently, a systemic approach has been commenced in 2014, by Ricky Whelan of the local Birdwatch branch which should regularise the recording and monitoring of the sites bird fauna. The list of bird species currently known from the site is shown in Appendix 1. Most are common within the area and none are solely confined to Abbeyleix Bog.

Recent birds of note from the site include Barn Owl first recorded in 2012 and a nesting pair of Buzzards along southern margins of site in 2012 & 2013. Some of the other notable species are residents, some summer visitors and include in no particular order Grasshopper Warbler; Kestrel, Linnet, Sand Martin, Swallow & Swift.

Three species were previously recorded from the site include Curlew, Redshank and Red Grouse. All are red-listed birds (Colhoun & Cummins 2013) due to their small national breeding populations. Meadow Pipits (also a Red list species due to recent population declines) are frequently recorded, while another two species with some indication of an apparent recent decline in breeding status include Snipe and Skylark (M. McCorry pers. comm). At present, there is no explanation as to what causal factors might explain this apparent decline, but it would be worthy of further monitoring. There are no major wintering bird assemblages on site, although there is an influx of some wintering species including Snipe and occasional Merlin (R. Whelan pers. comm.).

Along with the systemic recording, casual sightings should continue to be recorded. In this regard ABP Ltd are recommended to register an online account such as Birdtrack™, a widely used application managed by the British Trust for Ornithology (BTO) and BirdWatch Ireland (BWI). This would facilitate volunteer's easily inputting records (should they possess the app) for later updating of the database.

Of more importance is the recent implementation of annually planned monitoring scheme in accordance with the County Birds Survey (CBS) scheme. Ideally, bird breeding survey should be twice yearly conducted between March and early May. This enables a better understanding of all breeding birds and may suggest potential shortcomings in the knowledge that might be overcome by more detailed survey.

Where large colonies exist, then additional monitoring in the form of colony censusing might be considered. If done over a number of years it will allow the project to ascertain if numbers are steady, rising or dropping. This is a good indicator of what's happening locally and help tie-in with similar counts further afield.

Current records for raptors on Abbeyleix bog include Barn Owl, Kestrel, Sparrow Hawk, Merlin, Buzzard and Peregrine Falcon, although some of these species may hunt over the site occasionally or use the site as part of a larger foraging territory. A Raptor survey need

not be onerous and could easily be incorporated into the CBS survey. However, the data should be sensitively treated owing to potential impact from outside parties.

The installation of structures to facilitate birdwatching is not presently recommended at present as some are seasonal and indeed for others the varied habitats themselves present the opportunity to unexpectedly view the birds. In terms of managing the overall site for the benefit of birds - large scale tree or scrub removal on the high bog and in selected areas should only be carried out outside of the breeding season e.g. March 1st until August 31st. The work should be carried out in such a manner that no large openings or absences of vegetation are created that would potentially impact on bird species. All vegetative arisings that have the potential to regenerate should be disposed of off-site as per the recommendation in section 6.8. Cleared areas should receive no additional large scale management for at least 2 years. In this way, the disturbance to returning “site faithful” birds is minimised (R. Whelan, pers. comm.).

The retention of small trees or standing dead trees should be considered in areas outside of the high bog and cutover. In terms of best practice, the removal of a large proportion of trees (on the bog) would be ideal. Their presence, whilst potentially beneficial to birds, is indicative of the degradation of the peatland substrates owing to changing hydrological conditions. At Lodge Bog, retained trees were detrimental to some ground nesting birds as they were used as perches by Hooded Crow to predate the eggs of breeding Curlew (T. Ó Corcora, IPCC pers. comm.). In practical terms, the removal should be planned on a phased basis starting with the wettest areas, with trees on periphery of the high bog retained only where necessary as cover.

Recommendations

- As birds are readily monitored indicator species of a sites and its habitats health, the project should implement a structured bird monitoring regime that should include a Breeding Bird Survey, Colony Census and ideally, a breeding raptor census.
- Develop and populate database - Abbeyleix Bog Project Ltd should register an account with an online recording application to facilitate volunteers uploading records. This could later facilitate data input into the National Biodiversity Data Centre database
- Habitat management e.g. verge maintenance, tree removal should be carried out in the winter season between 31st August and March 1st to avoid disturbance to breeding species. Ideally, no large scale removal in any one place be carried out
- Consideration might be given to the possible retention of some standing dead on peripheral parts of the high bog and in developing wet woodland

- Identify areas of high conservation value where activities management, minor development or unnecessary disturbance from visitors be prohibited
- Define target species which might over time be naturally enticed to breed on site e.g, Snipe.
- As a further educational resource, consider provide bird boxes in visible places or where large numbers of trees removed so that impact is lessened and also to potentially improve viewing potential for visitors



Photograph 11: Common Lizard (*Zootoca vivipara*) in undergrowth (Source Mark Slattery)

5.4 Amphibians and Reptiles

In Ireland, both of these groupings are poor in numbers with only a handful of species between them. Two species, Common Frog and Smooth Newts account for the known amphibians on Abbeyleix Bog while Common Lizard (Photograph 11) has also been recorded in the past few years (MacGowan pers. comm.).

Frogs and their spawn (March to April) are commonly in pools and Algal-laden main drains along either side of the old Railway track. Listed as an internationally important species, they are wholly protected by Irish and European legislation.

Previously there were some sightings in land adjacent to the Bog, the presence of newts was recently confirmed from a drain alongside the main track at Abbeyleix Bog (F. MacGowan. pers. comm.). Newts whilst being widespread are often under-recorded as they are only found in still or slow moving water such as ditches and wetlands.

Recommendations

- Monitor areas of known spawn/frog congregation for impacts due to changes in hydrology or from other impacts from management operations such as periodic verge cutting in wet areas along the tracks
- Ensure and educate people that no collection of spawn be allowed except under licence (N.B. Open licence for schools with restrictions)
- Instigate IPCC's Hop to it Frog Survey to broaden the understanding and extent on site
- Develop a family based event based on IWT's recently finished newt recording scheme to try and confirm newts

5.5 Spiders

A limited sampling was previously carried out on the eastern edge of the bog by Mr Myles Nolan of the Natural History Museum. Of the 16 species that were recorded, two species of interest were recorded. The first was *Simitidion simile*, the status of which in Ireland was until recently uncertain. A second larger species is more readily identified - the raft spider *Dolomedes fimbriatus* is one of the largest spiders recorded in the British Isles. Its ecology is of interest in that it moves on the water surface but can submerge to hide from predators.

Given the brevity of the sampling, a considerably greater diversity would be expected if a comprehensive survey across the range of the site's microhabitats. Certainly, a number of Irish rarities are found only on raised bogs, some of which are of significant rarity across Europe *inter alia*, *Hypsosinga albobittata*, *Centromerus levitarsis*, *Minicia marginella*, *Satlatlas britteni*, *Walckenaeria alticeps*, *Pirata piscatorius* (M Nolan. pers.comm.).

A novel predictive methodology for enumerating arachnids at Abbeyleix has kindly been suggested by M Nolan. Details of this predictive approach are contained in Appendix 4. This approach could benefit Abbeyleix Bog as the 'expert knowledge' approach would be both less expensive and less time-consuming over traditional intensive sampling.

Recommendations

- Engage with Mr Myles Nolan regarding potential application of predictive approach using Abbeyleix as a test model to monitor spider species

5.6 Butterflies & Moths

Currently butterfly monitoring is carried out by two volunteers (Ms Annemarieke van der Voort & Ms Clare Coffey) whose results have been forwarded to Biodiversity Ireland weekly over the course of a number of months for several years. The protocol used is that of the National Biodiversity Data Centre's Butterfly Monitoring Scheme. The transect covers 4 sections along the main track, roughly corresponding with location of current notice boards, as well as a further 30 metres perpendicular to the track along a grassy patch as part of section 2. A further 5th unofficial section, not included in the counts is occasionally carried out and covers the remainder of the old railway track.

The site supports a considerable number of butterfly species (Dr T. Murray, National Biodiversity Data Centre, pers. comm.; Appendix 2). This diversity is largely due to the range and structural diversity of grasses, flowering plants, shrubs and trees providing food for developing larvae while nectar rich flowers support adult butterflies. The majority of recorded butterflies are known from along the access track, woodland and bog edges and the wet calcareous grassland that occurs in the depression along the existing Killamuck loop walk in the cutover near noticeboard 3.

One species of note from Abbeyleix Bog is the Large Heath. A once common species of bogs; it has seen a decline in National populations as a result of bog drainage and reclamation and is a red list species (Regan *et al.* 2010) with its current status as 'vulnerable'. Another species of note, however, the Marsh Fritillary has not recently been recorded on site despite the potential suitability of certain areas/habitats. Of all the resident butterfly species in Ireland, this Annex II listed species as defined under the European Union's Habitats Directive (92/43/EEC) is listed as Vulnerable (A2c) on the Irish Red List for Butterflies due to a decline in its population of $\geq 30\%$ (Regan *et al.*, 2010). Previously noted from Abbeyleix Bog (MacMillan 2002), the site was revisited in 2006 by Dr Emma Seale as part of her doctoral research. No webs were detected on the site during a single half day survey of Devil's-bit Scabious (its favourite host plant) along the margins of the Bog and in disturbed regions. A modified survey will be commenced from mid to late August 2014 (Dr. E. Seale pers. comm.).

In terms of overall management, the optimum scenario for butterfly conservation on parts of the site, given the vegetation and habitat mosaic includes

- areas of bare ground – for basking

- patches of short, open turf which is crucial for some food plants
- tall grass – provides an egg laying site and as a refuge/cover for overwintering larvae
- Plants in all stages of development from seedling to flowering to dead heads and including nectar-rich food sources from a variety of trees, shrubs and flowering plants
- Nectar-rich food sources
- Cover – hedges or scrub on which adults feed, rest, perch and use as a transit corridor to other suitable areas within the site.

Some reservations had been raised, during the consultation process, about the impacts of some aspects of site management that had been undertaken at Abbeyleix Bog. They relate to large scale linear vegetation clearance as part of the verge maintenance and the storing of aggregate along a part of the access trail near the entrance of the site. A considerable amount of trees and shrubs were cleared and the verges severely cut. Seemingly destructive in terms of butterfly habitat, the herbaceous vegetation was quick to re-establish.

In terms of Moths, the 36 records for the site come from a single trapping event that was carried out by Ms Ciara Flynn, District Conservation Officer for NPWS as part of the 2013 Bioblitz. This was done by using non-lethal light traps, which is the preferred methodology. Ideally the Robinson trap, the standard against which all others are compared (UK Butterflies and Moths) is the preferred choice amongst serious entomologists because it offers the greatest attraction for moths. For many, however, it is a difficult group requiring some skill, patience and a keen eye to distinguish subtle species differences. Optimum times for trapping moths are July and August. Given the range of habitats and the fact that only 36 species were recorded, it could be suggested that there are still a considerable number of moths unrecorded from Abbeyleix.

Recommendations

- Prepare a detailed map of the monitoring transect – allows for continuity so that new personnel can continue monitoring where necessary
- The management of the site, in particular large-scale vegetation removal/clearance must take cognisance of the potential impacts on butterfly diversity

- Alongside the scheduled butterfly monitoring, encourage family participation in Dublin Naturalists Field Club Butterfly Recording Scheme and for the National Biodiversity Data Centre
- Implement a modified survey and recording technique (<http://butterflies.biodiversityireland.ie/rare-species/marshfritillary/larval-web-form/>) for Marsh Fritillary

5.7 Insects

A number of groupings are jointly detailed here, though spiders and butterflies/moths are separately dealt with given the larger number of records. They are the most numerate grouping recorded in Ireland ~12000 with new records each year. It is clear that the records for Abbeyleix Bog (shown in Appendix 2) are far from complete. Most of the data was collected during the 2013 Bioblitz event which corroborated many of the casual records previously noted. Easily recognised as an insect, this grouping may be overlooked in terms of documenting as they are highly mobile; or require specialist knowledge for accurate identification.

Of the groups described here, dragonflies have 5 separate records. Indeed one has been selected as the iconic logo for Abbeyleix Bog Project. The range of habitats and the diversity within the beetle family is such that it would be expected that numbers far in excess of 3 recorded species should be known from Abbeyleix. Similarly, only four types of bees have been documented with no wasps or hornets, as might be expected. Abbeyleix Bog has records for five grasshopper. The most notable species, the rare Large Marsh Grasshopper, was confirmed in 2012 by Dr. Eugenie Regan of Biodiversity Ireland.

Recommendations

- Continue collecting records, pictures or specimens (if dead) about insects
- Encourage seasonal events, family or otherwise, for seasonal preference for collecting specimens
- Develop partnerships with experts so that difficult finds can be identified
- Encourage events to be held on the site such as IWT's Ladybirds recording schemes

5.8 Molluscs

This grouping is currently under-recorded at Abbeyleix Bog. The 2013 Bioblitz event returned a single molluscan record, namely *Pisidium* spp. a small freshwater pea clam, though earlier records exist for approximately 40 species. Commonly observed snails include Black Slug, Garden Snail and Valve Snail. The record for Desmoulin's whorl snail, an Annex II species, first noted as an empty shell (McMillan 2002) has not been reconfirmed from the site. Moorkens (1999) and Moorkens *et al.* (2007, 2011) do not list Abbeyleix Bog as a site for the snail. Its presence, if reconfirmed, would represent an ecologically significant find for the site.

Recommendations

- Further reconnoitring of suitable habitats within the site may reveal more species

5.9 Fish

In terms of other fisheries potential, the site has little to reveal by way of records. Despite the preponderance of water in places on Abbeyleix Bog, notably along the eastern perimeters, it is the lack of suitable oligotrophic watercourses, with direct connections to larger rivers that may account for the paucity of records. Previously, only Three-spined Stickleback has been recorded from sections of a narrow stream along with Trout in a river outside of the leased bog area (M. McCorry pers.comm.). Further downstream at the tie in with the River Nore, both Trout and Salmon are well documented.

Brook Lamprey, an Annex II species, was newly recorded from the site during the 2013 Bioblitz event (Photograph 12). It was found in a section of stream, characterised by a clean gravelly substrate, at the eastern margin of the site, where the stream enters the bog.

Inland Fisheries Ireland in response to the consultation request note that the potential for importation or introduction of non-native plant species (such as Japanese Knotweed and Himalayan Balsam) or future management operations such as peat damming using mechanised machinery or the large scale felling of trees could result in the introduction of non-native species into watercourses within parts of the bog system, potentially resulting in their spread downstream into the River Nore or Owenbeg Rivers.

Recommendations

- Monitor the Brook lamprey population and recommend that the site be included in any future Lamprey survey of the wider Nore catchment, particularly in light of potential siltation from plantation clearance or nutrient enrichment from adjacent agricultural land
- Ensure that in the course of any operation including installation of peat dams, that the importation or introduction of non-native species not be allowed into watercourses within the bog system



Photograph 12: Brook Lamprey (*Lampetra planeri*), a primitive and jawless relative of fish was recently found in a stream on the site. (Source Mark McCorry)

6 Management Issues and Recommendations

This section discusses some of the main management issues that are considered relevant by the Technical Advisory Group. Not all of the objectives are directly linked with the standard conservation management practices per se but are considered important in realising the core objectives of the CMP. It is a fundamental requirement of the project that the recommendations be practical. That being so, it does not necessarily equate with inexpensive or a once-off operation. From the outset, Abbeyleix Bog Project Ltd should be clear that some of the tasks, many of them priority objectives are onerous.

It is implicit, given the range of topics presented here, that some of the understanding or indeed knowledge about the site is incomplete. Hence the findings simply recommend

further consultation with appropriate agencies or engaging the services of an appropriate expert(s) to develop a particular aspect.

6.1 Hydrological Management of the Bog

The hydrological management of bogs is intimately associated with its development and persistence. As with most raised Bogs in Ireland, human intervention in the hydrological management through drainage and cutting etc., has considerably altered the extent, quality and diversity of these bogs. The manmade lowering of the water table dries the peat allowing oxidation to occur, often resulting in an increase peatland acidity and potential acidification of adjacent/linked watercourses.

A number of restoration projects have been attempted for wetlands in Ireland and further afield. While some have had specific conservation goals, others have combined nature conservation or management with tourism, education or income-generating activities such as birdwatching etc., In Ireland the largest rehabilitation programme that has taken place is at Lough Boora Parklands, a site of approximately 2000 hectares. Other sites much studied and under restoration include Clara, Raheenmore and Sharavogue bogs. Restoration can only be successful when the whole bog is treated as a unit (J. Ryan NPWS, pers. comm.).

For most people interested in restoring peatlands, there is an innate need to understand the hydrological functioning across the bog surface as well as its subsurface movements. The presence of a water table close to or at the surface is often indicative of a healthy peatland system. In terms of conservation management, fully understanding the hydrological regimen relies upon the expertise of a range of different disciplines – hydrology, geology and ecology. This inclusive approach is still in its infancy in Ireland. There are a small number of sites/projects for which such detailed information is available such as Clara Bog, but at present most Irish studies are standalone projects with little detail as to the interconnectivity with other wetlands.

Figure 5 based on a combination from LIDAR analysis and fieldwork to map drains represents an image revealing the depth of peat within the cutover areas and by corollary the dryness or efficacy of drainage within the area. The blue area largely corresponds to

the high bog. The picture by itself is somewhat misleading regarding the dryness of the cutover, as some red areas on the map (northern eastern corner) correspond with water-filled depressions. Thus any peatland restoration through rewetting these areas would be futile and probably negatively impact upon some of the bog woodlands types encountered here.

Presently, the raised bog project being carried out by RPS consultants on behalf of National Parks and Wildlife Service is examining potential models based on mathematical Digital Terrain Modelling through interpreting LIDAR, slope and other data (Anon 2014c). Previously large scale rewetting has been carried out on much of the High Bog at Abbeyleix and a considerable number of drains across the high bog only were blocked in 2009.

The NHA review (anon 2014) contains information from the ongoing raised bog project and an eco-hydrological assessment of Abbeyleix Bog test site based on 2009 field-data and Digital Terrain Modelling. Of the entire high bog, 1.1ha is considered as active raised bog, with 99.4ha classified as degraded raised bog. A further 4.6ha of degraded bog presents the potential for restoration to active raised bog through rewetting. These results while seemingly small are positive. However, additional rewetting should not be carried out at Abbeyleix Bog until the modelling to determine which techniques will prove invaluable is finalized.

The efficacy of the emplaced dams already in place can only be confirmed with further detailed ecotope surveying of the site. Predicting how management interventions will develop in low-lying or cutover areas of the bog can be less certain, especially if the potential for water loss from the system is unknown. Were funding forthcoming, the installation of piezometers (a number of which are already in place from a previous research project) would allow ABP Ltd and partners to groundtruth the final model's efficacy and allow for refinement and/or incorporation into management objectives at other sites.

(courtesy of F. Fernandez, NPWS). They may yet be refined as further information develops.

Map 1 - Modelled Potential - This map indicates the potential for the development of active raised bog (ARB) on the high bog. It is estimated that 5.05ha of active Raised Bog could be restored in addition to the existing 1.12ha at Abbeyleix bog.

Map 2 - Drainage - This is an important dataset though indicative only at this stage of flow paths on both high bog and cutover. The results from this map suggest which areas of cutover will provide the best restorative potential (i.e. higher extent of peat forming habitats (active raised bog, poor fen, wet woodland) if drains are blocked etc. A secondary benefit of this map is that pooled water and flow is visible on the railway embankment track. This will prove useful with the potential improvement of this track.

Map 3 - Enclosed Depressions – this map shows cutover areas where localized depressions occur and which would have better chance at generate peat forming habitats if additional restoration works are carried out.

Map 4 – Slopes – The final map highlights cutover areas with slopes of between with 0.5% and 0.3%. Areas with <0.3% slopes seems more appropriate for peat forming habitats, though other preliminary fieldwork data from the project would suggest that depressions may be more reliable indicators of potential peat forming areas than areas with slopes <0.3%.

The results of the predictive modelling is based upon research initially carried out at a small number of sites but subsequently increased and includes Abbeyleix Bog. Factors such as surface shape, slope and drainage patterns were all important in forecasting potential restoration areas, where topography is suitable for active raised bog to be restored following measures such as drain blockage.

There is relatively small potential for active raised bog regeneration on the high bog (F. Fernandez NPWS pers. comm.). The greatest potential to restore peat forming habitats at Abbeyleix Bog is in the cutover bog as well as some of the transitional areas from the high bog and lagg areas. In terms of practical restoration and early findings from the research, a number of areas have been identified through early modelling that might be beneficial. However, as the information is still indicative, it is summarily dealt with here

and final full details of the analysis will be presented to Abbeyleix Bog Project Ltd. in due course (F. Fernandez NPWS, pers.comm).

- Middle West of the high bog area - Blocking of drains perpendicular to face banks on the open ground area would be recommended to encourage the formation of more raised bog wet habitats
- North West section – blocking drains perpendicular to face banks recommended. However, may conflict with access track and require a potential solution such as raised boardwalk
- North East section – potential for blocking drains and recreating some additional bog habitats. Would require sensitive approach as could impact other features of interest on site
- Eastern section – already quite wet so minor blocking of small, number of drains. Key requirement would be ensuring no impact hydrological or otherwise from adjacent quarry on Lagg zone
- South East – There is some information regarding the restoration adjacent to the peat forming habitats adjacent to some facebank areas. However, the absence of LIDAR data, levels and vegetation cover from much of the area presents difficulties with regards finalizing its full restoration potential
- South West Section – Blocking of drains perpendicular to facebank recommended. However, this would impact on a large section of Killamuck looped walk as well as the privately-owned conifer Plantation on opposite side of main drain.

Further considerations would need to be given to blocking of all drains on the cutover to reduce water loss. Some hydrological monitoring is required to establish water levels in key drains. Also rewetting of double drains along either side of the railway track embankment trail need careful consideration and design, especially around areas where public cross such as at boardwalk entrance onto High Bog. As with any scientific endeavor, to further improve upon the accuracy of this preliminary modelling, further research e.g. hydrological status and botanical fieldwork will be required.

Despite the positive conservation objectives benefits of restoring bog habitats, there are other concerns which must also be addressed. Parts of the site could undoubtedly become wetter, potentially hindering access along some trails. Any rewetting solution could require revising sections of some walking routes (not all under the aegis of

Abbeyleix Bog Project Ltd.) - raising parts of the railway embankment trail or the installation of additional boardwalks in wetter parts of the looped walkways. The benefit and costs, for a local community group, associated with these additional works might overshadow but ultimately not curtail the positive impacts of habitat restoration.

There is some potential for restoration works in the cutover areas to impact on adjacent, often privately owned land. During the consultation for the plan, a number of landowners expressed genuine concern about potential increases in surface water levels leading to flooding or creating difficulties in relation to carrying out business such as farming or removal of plantation crops. Other stakeholders do not consider the blocking of drains to be significant in terms of the potential benefits to the site. A number of recommendations in relation to the impact on wildlife and habitats are suggested for any future restoration works. In the interests of avian fauna, ground works on installing dams would best be undertaken outside the likely nesting season for ground-nesting birds (A. Copland, Birdwatch Ireland pers. comm.). Inland Fisheries Ireland, whilst recognising that there is a low risk of sediment loading from drain blocking, the risk remains for short term increase in sediment as a result of mechanical emplacement. Mitigation measures should follow the guidelines in the ERFB guidance (Murphy 2004).



Photographs 13 & 14: 13) Drain blocking in 2009 (Source Chris Uys). 14) Thriving vegetation over dam (centre of view) and elsewhere on high bog.

In terms of conservation management, arresting any further decline in the condition of the raised bog is crucial. The implementation of a rewetting programme to increase the extent of active raised bog habitat is important given the current status of this priority

habitat in Ireland. It would count towards fulfilling the National obligation under the Habitats Directive to maintain or restore Raised bog habitat to Favourable Conservation Status (FSC).

For Abbeyleix Bog Project Ltd, the realisation of this objective would require considerable planning and financial resourcing, such as might only realistically be expected from conservation partners such as NPWS (especially if the site is designated). At conservative 2014 prices, a simple dam (mechanically emplaced) costs €30 and a drain may require between 5 and 15 dams per 100 metres depending on topography (J. Ryan NPWS, pers. comm.). The recommended restoration and subsequent maintenance of the site should ensure the hydrological integrity of this bog, whilst at the same time supporting the diversity of its other wetland habitats and myriad species found therein. It could also provide flood attenuation to downstream areas. Whatever course of action is taken at Abbeyleix, it will require detailed consultation and the agreement of adjacent landowners/stakeholders as well as financing.

Recommendations

- Refine rewetting plan for Abbeyleix Bog so that future restoration works be carried out on a phased basis to lower potential impacts
- Initiate detailed consultation, in conjunction with partners such as NPWS, with landowners and other stakeholders
- Recommend that no additional restoration works such as drain-blocking be carried out where there is potential to impact on adjacent land-owners or impact on other objectives of the CMP such as maintenance of looped walks
- Redo ecotope survey in the near future and at regular periods thereafter to monitor the efficacy of hydrological management and success of potential restoration

6.2 Vegetation Removal

A number of different operations come under this heading. In order of considered priority they range from the removal of invasive plants as well as other trees from the High Bog, to guaranteeing access along tracks or in developing boardwalk routes and finally site accessibility/attractiveness. Note that owing to the considerable risks involved associated during the course of vegetation removal that a specific section detailing the health and safety consideration for the more onerous operations is presented in Section 6.9.

6.2.1 Tackling Rhododendron

Rhododendron has for some time been an established problem at Abbeyleix Bog and parts of the surrounding landscape. The encroachment by this invasive shrub quickly reduces light penetration to understorey plants, in both woodland and to some degree in bog habitats. The cutover bog areas seem to be more vulnerable at present to colonisation, compared to the high bog, although Rhododendron is also present on the high bog. Rhododendron poses a serious ecological threat, one which is a priority objective of ABP Ltd. The effective management of this invasive species will require a phased approach that is both labour intensive and lengthy in duration.

For the past two years, the funding from the Rural Social Scheme has enabled a start to tackling the Rhododendron whereby a simple methodology involves cutting it back almost to ground level and stacking it onsite (Photograph 9). There has been some apparent progress along parts of site, however, the regime is in its infancy and will require considerable dedication and time to manage, especially as some of the areas already tackled have seen the regrowth of Rhododendron. A naturally seeded plant does not flower until 12 years old. Thereafter it can spread rapidly; a seed can germinate under suitable conditions within 5 days and a flower produces approximately 1 million seeds which can be aurally dispersed up to 1 kilometre away (Barron, undated). Of immediate concern is that Rhododendron spreads rapidly by layering, a fact which is patently evident at Abbeyleix (Photograph 10).

The primary focus for ABP Ltd. in tackling Rhododendron is in prioritising those areas where significant populations of the shrub exist, particularly around trails or the boardwalk. This will require a systematic survey of the entire site and adjacent land (where permissible) where it is known to occur. It may be advantageous in the short term to avoid large, mature stands with little or no native vegetation beneath them. Rather it is recommended that less seriously infested areas or outliers be tackled in the short term.

By way of example, the Coillte LIFE Raised Bog Project, also had to deal with Rhododendron infestations. Large shrubs were initially cut back with a chainsaw and large root systems removed with an excavator. The stumps were allowed to regrow for one year and then treated with a glyphosate herbicide, i.e. Roundup. Subsequently this was repeated at least every second year in order to year to kill off any persistent regrowth

(J Conaghan pers. comm.). As the example demonstrates, the cutting and removal of the plant and its later destruction will by its very nature be taxing for ABP Ltd. It will, in all likelihood, take many years.

A standardised methodology proposed for dealing with the problem has been developed for sites of ecological interest, issued by the Forest Service/Woodlands of Ireland (Barron Undated) makes for important reading.

The first operation in clearing rhododendron is the cutting of individual stems with hand or chainsaws. Burning under the supervision of personnel with fire experience is another option that has in certain situations proven effective. This option is obviously not recommended for Abbeyleix bog. After cutting, it is recommended that the material be brought off site so that follow up operations not be hindered. Burning off-site of the dead material approximately 1-2 years post removal is recommended by the guidance (again under supervision and in an appropriate area so as not to pose a fire threat) rather than leaving it on site to decompose. Guidance will be required from appropriate personnel.

Invariably the rhododendron is fast to recover. It can vigorously regenerate after cutting. There are four main approaches to killing it off.

- Digging out
- Direct stump treatment
- Spraying of regrowth and large seedlings
- Stem injection

While each of the above four regimens has pros and cons, not all are considered practical solutions for the Abbeyleix Bog Project. Given the difficult nature of the terrain and sensitivity of the sites' hydrology, the recommended option is for stem injection. This is a controlled methodology, most often used in situations where rhododendron bushes/trees are established (Edwards 2006) and minimises the impact of pesticide drift to surrounding vegetation as well as drains, streams etc.

It is important to remember that Abbeyleix Bog will always remain vulnerable to reinfestation from onsite sources and infestations on adjacent landholdings. It will remain problematical until dense, natural ground cover becomes re-established. This will not always be the case within parts of the vegetative mosaic at Abbeyleix Bog. Concurrent with the removal of the rhododendron, the systematic checking of the site for

reinfestation and regeneration will be tedious but a necessary process if the problem is to be effectively tackled, particularly where material might arrive from adjacent landholdings.

6.2.2 Removal of Trees from High Bog

Over time, a considerable number of trees have spread onto the high bog. The majority are naturally seeded from adjacent plantations, although historically some were likely planted as cover or screening, such as alongside the eastern perimeter of the site in plantation. The spread of scrub woodland is often indicative of unfavourable peatland conditions – notably a drying out of the bog and can potentially lead to a fragmentation of the habitat.

The presence of tall or mature trees either as singletons, copses or as large plantation stands on peatlands is also considered negatively impact certain bird populations. Birdwatch Ireland have developed a Raised Bog Birds Species Action Plan (Birdwatch Ireland 2011) which details how raised bog birds (ground-nesting species) tend to avoid areas of cover, preferring open terrain as part of their predator avoidance strategy. The cover afforded to foxes, as well as perching habitats for carrion species has been cited in increased predation of young or ground nesting birds in exposed Peatland habitats elsewhere in Ireland (A. Copland, Birdwatch Ireland pers. comm).

Like many other Peatland sites that have been extensively drained, Abbeyleix Bog is being colonised by Scot's Pine and Birch although in some older cutover areas, Beech and Sycamore have also become established. With the exception of Scots Pine which is regarded as native problematical rather than non-native or invasive, all are problematical in terms properly functioning bog habitat and ideally should to be removed from the High Bog; and parts of the cutover.

Based on the findings from other raised bogs across Ireland, the ideal rate of removal of non-natives or invasive species varies from site to site, from immediate removal to a more gradual removal over a number of years, depending on a number of criteria such as cost, manpower, accessibility etc. At Abbeyleix Bog, the invasive species need to be removed as they intercept a considerable portion of rain that might otherwise reach the peat surface.

For the most part the pines occur as stunted specimens on the high bog. They are apparent, often occurring in near regimental fashion in wetter parts of the Bog. Although abundant is not thriving and is greatly stunted owing to impoverished nutrient status of the bog. As rewetting progresses, the rising water table will gradually kill off pines on the wet bog. They could be removed, but it may be that they are left to perish and wither. Ultimately that is a decision for ABP Ltd. to assess the priorities and implications for its volunteer workforce. Elsewhere mature pines occur but are largely in other habitats or adjacent landholdings. Ideally, where they impact the high bog in terms of occurring on it, they should be removed, particularly in the wetter areas of high bog and in the areas indicated by restoration potential map (ref) as having potential to develop into active raised bog. Conversely, it is important to distinguish and retain valuable habitat containing long established Pine in peripheral areas such as Ballymullen Plantation adjacent to the valuable Lagg area and its retention.

Birch and Willow to a lesser degree is widely distributed throughout the raised bog. Some occur as singletons whilst others occur as small copses or imitate short treelines (*sensu* Fossit 2000) along linear features on the bog. In the main these should be removed, particularly in the wetter areas of high bog, except in situations where bog woodland or similar develops or is sustaining.

Natural regeneration of wind-borne seeds of Downy Birch and Pine will continue at Abbeyleix after a tree removal programme is initiated. It is likely that this will continue many years after the initial clearance has taken place. Results from the Coillte LIFE raised Bog project would validate this fact as after clearing trees from bog sites, they had a lot of regrowth of trees and scrub, due in part to the watertable being too low (J. Conaghan, pers comm.). Their presence should be monitored and a periodic programme of removal should be enacted.

Although the tree species described above are all considered invasive (on Peatland ecosystems), the need for a felling licence to be obtained prior to works being carried out (except in the case of an overriding Health and Safety concern) may still be required if trees are over 3metres tall. In addition, Ministerial consent might also be required should the site be designated for conservation purposes. Seedlings which are less than 30cm tall can usually be pulled by hand. Pine saplings generally don't regenerate after they have been cut or strimmed. Birch, however like willow does (J. Conaghan pers. comm.).

For larger trees, best practice allows for handsaws or chainsaws to be used, the final decision being dependent upon the resources of ABP Ltd. Trees should be cut down to as near to ground level as possible and the stumps treated immediately with an approved herbicide approved for use in Ireland by the Department of Agriculture, Food and Rural Development. Elsewhere in larger plantations occurring on Bog, a proprietary brushwood killer containing Triclopyr® or Roundup has been found by some to be effective, although the Coillte LIFE Raised Bog project did not resort to chemical treatments as their aim was to wet the sites and encourage them to die off over time (J. Conaghan, pers. comm.). Indeed, herbicides will unlikely be needed for trees in wetter parts of the bog as they will rarely thrive. It may be that phased use of herbicide might be considered on trees occurring in selected drier/cutover parts of the bog and if so, the addition of a food dye is to be recommended so that treated stumps could easily be recognised. Felled trees should be removed from the site, although some advocate using the felled wood in drain blocking.

Recommendations

- Develop a site specific method statement to tackle tree removal
- Prioritise areas to be tackled both on the high bog for removal of all trees (where deemed problematical) and cutover areas.
- Important to retain all trees in extant areas deemed as Bog Woodland or cutover areas with potential to develop into Bog Woodland Retain all trees in areas deemed to be Bog woodland

6.2.3 Verge Maintenance

There are practical reasons in maintaining year round access to the trails, in as far as is practicable. Firstly, the maintenance of access ensures that, if necessary, emergency vehicles can attend an incident in a timely manner. Secondly, it ensures that visitors can with high expectation safely appreciate the site and its various vistas.

Vegetation develops over time, and in the absence of management can result in excessive growth that can overshadow other habitats or hinder access. A case in point presented itself in the summer of 2013. The main access route was heavily overgrown and in places so narrow that emergency vehicles responding to a fire on the bog had difficulty manoeuvring. Thereafter, a dramatic and severe flailing along either side of the track was carried out (Photograph 15). The ground flora recovered the following year and the impacts (nesting, pupating and feeding) on species such as butterflies and birds

diminished. It is recommended that future operations, where necessary be phased leaving patches of vegetation. Nor should the same area be cut in successive years. The ideal situation in terms of managing the verges for butterflies is that the vegetation has a varied structure with a mixture of larval food plants, leaf litter, some clearings and open ground for warm sunny conditions.

In practical terms, there is a suggestion that the most effective method for cutting grass along the track is by a single chop silage harvester, although a suitably powered tractor and silage trailer would be required (Gary O’Keeffe, ABP Ltd., pers. comm.). It is not known if the phased cutting regime that is recommended in the CMP will suit large scale machinery however. Notwithstanding this fact, the disposal of all material would have to be offsite, so as not to contaminate or enrich the local hydrology.

Recommendations

- Survey and map the entire site for presence of Rhododendron – Repeat regularly while rhododendron still present on site or adjacent land
- Prioritise areas to be tackled (will involve consultation with local landowners)
- Develop a site specific plan to deal with removal of material
- Conduct follow up surveys of cleared areas
- Consideration should be given to contracting professional assistance for large areas
- Prioritise areas on high bog for removal of all other tree species
- Remove as many as is a practicable
- Establish a programme to monitor new recruitment or reestablishment of trees

6.3 Walking Routes

Prior to the commencement of any development within the Bog by ABP Ltd, two separate looped walks had already been developed within and adjacent to the site, namely Killamuck Bog Loop and Collins Bog Loop walk. Developed in conjunction with Failte Ireland, Abbeyleix Business and Community Development Forum and Laois Partnership. Both loops traverse Abbeyleix bog to differing degrees and extent; and in places overlap. Details of both walks are freely available e.g. Killamuck Bog Loop Walk: <http://www.irishtrails.ie/Trail/Abbeyleix-Loops---Killamuck-Bog-loop/623/> and Collins Bog loop Walk: <http://www.irishtrails.ie/Trail/Abbeyleix-Loops---Collins-Bog-loop/622/>.



Photograph 15: Much of the overhanging vegetation and excessive growth along both sides of the main track was drastically cleared in late 2013. The vegetation has been quick to recover without blocking the path (yet!). (Source Chris Uys)

Trampling damage and dereliction is evident along the path particularly in wetter parts. Trampling damage either forces walkers back or out into surrounding habitats thus expanding the problem through a process known as ‘braiding’ where several paths develop.

Improving the access throughout the site is a key objective of the project in terms of developing the education remit as well as health and safety of all visitors. The provision of a boardwalk is an integral feature of the project, one that will, when finished will allow people to appreciate and enjoy this type of habitat. Clearly there is always a risk of disturbance to breeding species from people venturing into the middle of the bog, but this has to be weighed against the value of the habitat in educating and promoting the value of such habitats and their biodiversity to a wider audience. The boardwalk is intended to allow people of all ages and a certain level of mobility to access the site and marvel at its natural beauty whilst at the same time limiting damage of precious ecosystems or disturbing ground nesting birds. It will also further integrate the site, improving upon the two existing looped walks, thus making the site more attractive for visitors of all inclinations.

The finished boardwalk is planned in three sections. To date, approximately 300metres of boardwalk, which give the best appreciation of the high bog, has been completed

(June 2014) (Figure 5). As funding allows, the remainder of the boardwalk will be installed, further integrating the remaining areas of ecological and amenity potential within the site.

Recommendations

- Continue funding drive to enable boardwalk to be finished
- Monitor usage to see where potential issues arise e.g. slippage, handrails
- Discourage visitors straying off boardwalk into potentially sensitive nesting areas
- Consult Irish Trail Network regarding upkeep of derelict/impassable sections of the existing Looped walks

6.4 Education

Abbeyleix Bog has the potential to provide an educational resource that is rarely matched at most other publicly accessible amenities. The scientific information garnered over the past number of years as well as the vegetation mosaic mean that there is a valuable baseline to begin with. Despite previous research projects, reports and wildlife events such as the 2013 Bioblitz, that have garnered a significant ecological baseline for the site there is still an incomplete knowledge of the flora and fauna of the site. Some of this outstanding knowledge is detailed in Section 5.

A logical progression regarding the incomplete or outstanding dataset is the potential for further studies to be initiated or for research projects to be developed. The business plan (Kearney Consultants 2012) for the site recognises this commodity and has projected that the site could sustain a number of different educational models.

These include:

- Programmes for Enjoying Nature for primary schools
- Ecology fieldwork courses for second level schools
- Transition year field projects and Young Scientists projects
- Research opportunities for third level educational facilities

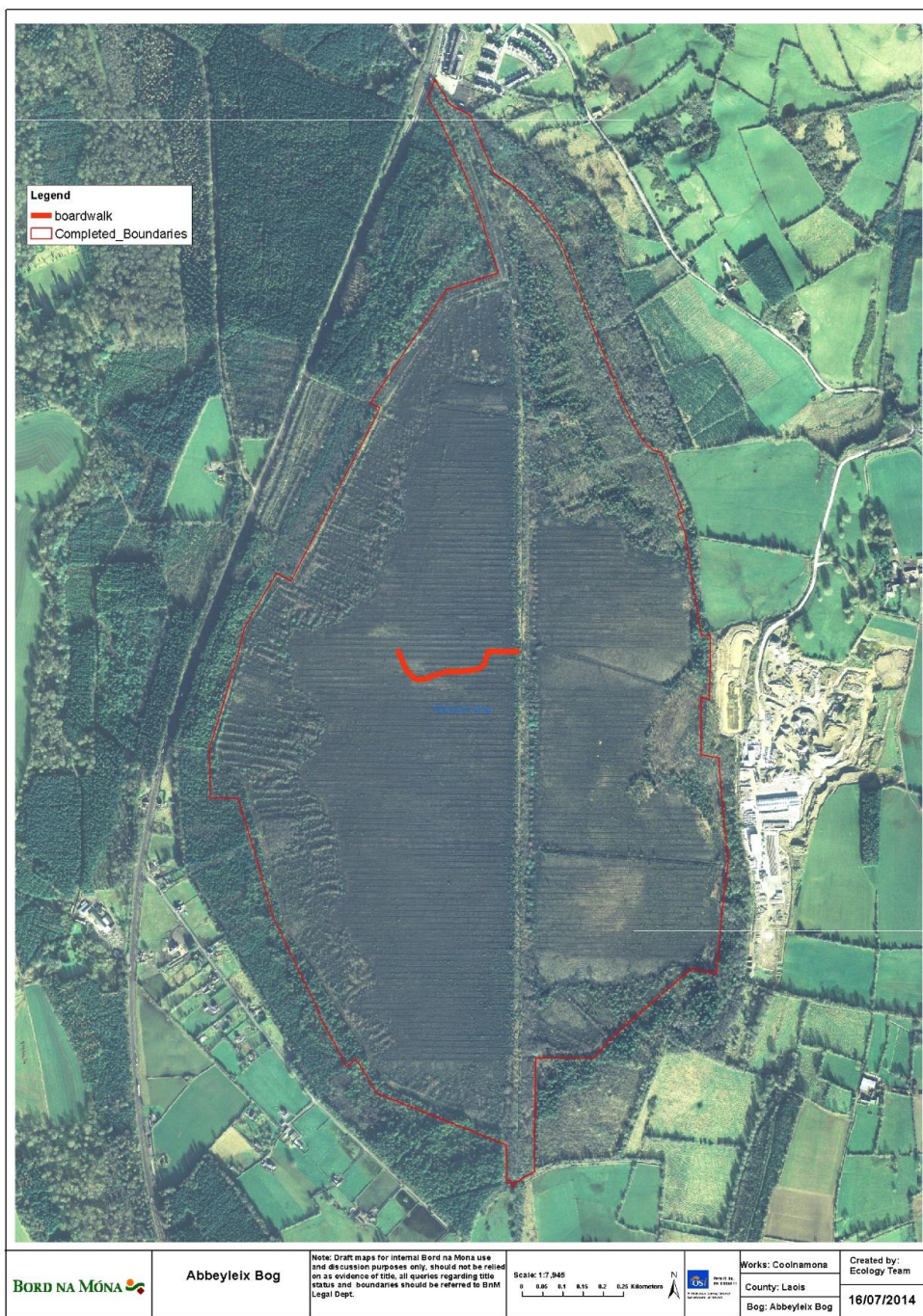


Figure 5: Map showing location and extent of first phase of boardwalk (Source Mark McCorry, Bord na Móna)

In terms of primary and secondary educational users, Abbeyleix Bog readily lends itself both to self-guided or guided visits. Use of the site will encourage local heritage

education in schools. Applicable teaching resources for self-guided visits that are freely available online include:

- IPCC Bogs in the Classroom program (<http://www.ipcc.ie/discover-and-learn/resources/>). This program includes show to design scavenger hunts, field studies and bog plant identification handbooks
- Tree Council of Ireland schools initiative (<http://www.treecouncil.ie/initiatives/schools.html>). Includes several posters, worksheets and information sheets for all age groups. In addition, they also supply a range of A2 sized posters regarding tree identification etc.

In addition there are many websites and organisations that have produced identification sheets such as Field Studies Centre (<http://www.field-studies-council.org/publications/fold-out-charts.aspx>) who carry an extensive range of laminated charts or Dublin Naturalists Field Club (<http://www.dnfc.net>) – Butterfly guide not to mention the many wildlife keys that abound. These would benefit any teaching programme or potential small research project.

The development of organised teaching courses whereby schools would arrive and be led by an expert is another worthy proposal for Abbeyleix. Ideally the candidate would be registered as a *Heritage in School* specialist. In terms of habitat education the program might mirror established outdoor education centres that run classes specific to a particular habitat e.g. IPCC in Lullymore or some Education and Training Board centres (formerly VEC) such as Baltinglass – Woodland Ecology. However, a notable difference for this venture however, is the juxtaposition of several habitats within a relatively short distance on a single site and the relative ease of access. Thus possibility of catering to different education needs must be a key selling point. It should be noted however, that potential changes in the junior certificate assessments may result in a key change in ecology coursework from a defined habitat project to an individual student selecting their own project as part of the examinable coursework.

No matter what education programme is developed, there will be an increase in visitor numbers albeit localised. They bring with them management issues that need to be addressed prior to the commencement of any education offering (Nuala Madigan IPCC pers. comm.). These include care of the site – careful selection of routes and activities so as to minimise damage to Peatland surfaces; facilities such as eating stops, toilets and parking – all important when guiding groups of younger children outside of the normal

classroom situation; and importantly health and safety concerns such as restricting access to certain sensitive areas or where deep water occurs, maintaining the access routes including the boardwalk etc.,

In terms of higher education, there is considerable potential for developing projects whereby absences in scientific knowledge might be overcome through approaches to interested parties/Agencies/Educational bodies. This will require a level of contact and management, but is not unreasonable. Previously in 2013 BnM partnered with a research student from UCD on a small project that looked at the condition of several ecotopes on the bog (Stapleton, 2013). This was only a short term project but there is considerable scope for pursuing field-based research. Monitoring is an essential part of understanding ecosystems and any results would ultimately feed into refining the understanding and hence management of the site. There is also potential to encourage 3rd level institutions to use the Bog for teaching purposes such as fieldwork components including habitat mapping. Ultimately, the results could prove invaluable to the Abbeyleix Bog Project as the data could remedy deficiencies in the knowledge base and enhance the understanding of the functioning of this peatland and its associated habitats.

As part of the wider educational resource, public noticeboards already highlight key features/insights into the site. There is no suggestion that further noticeboards be emplaced. Merely that the information sets be developed on the website (easily downloadable where necessary) for all to access the information. These must be developed as part of the ongoing branding exercise. Ideally the leaflets would not be overly detailed as the reader could be directed towards the website or onsite information boards on site. The downloadable leaflet should at the very least contain a map, and some introduction and history of the site and include some key characteristics or flagship species.

Recommendations

- Develop awareness of the site as an educational resource – market the site among schools etc., for guided or self-guided coursework
- Map and design a “wildlife orienteering course” with suitable stops for different educational needs.
- Prepare digital information packs that can be downloaded by schools
- Identify outstanding knowledge deficiencies for the site and develop a work schedule regarding particular species/habitats

6.5 Integration of the Bog with the wider community

The original town of Abbeyleix grew up beside the River Nore as a result of the establishment of the Cistercian Abbey in the 12th century. Later as the area was prone to flooding, the market town was relocated to its current location by the de Vesci family. The heritage town is now easily recognised, owing to its streetscape remaining relatively unchanged since its inception in the 18th century. The town boasts several notable buildings and sites of interest, many of which were instigated by the de Vesci family who remain associated with the town to this day.

Unlike most of the other sites of interest within the town, Abbeyleix Bog is situated at the southernmost edge of the town. Despite its relative proximity to the town and although signposted in places, it is probably overlooked by some.

A recent coherent approach – development of a website, information leaflets etc. by a cooperative partnership between Laois County Council and Abbeyleix Business and Community Development Forum is a positive step to promoting the town (B. Maher Abbeyleix Business and Community Forum, pers. comm.). It stands to reason that Abbeyleix bog can only benefit from a wider audience that may learn about, and visit the site. But these initial steps at branding the site is but the first steps at branding of the site is only the first step toward an integrated conservation management of the site. The idea of Branding is dealt with in section 6.6.

The tidy towns competition is another community based programme which is aimed at improving upon the local area. As the competition has developed over the years, judging criteria look for communities that are more sustainable, a fact recognised in 2012 when that Abbeyleix won the National Award for its Sustainable Plan (M. White, Abbeyleix Tidy Towns committee, pers. comm.). The scoring for the competition increases as a result of following up developed plans with concrete actions.



Photographs 16 & 17: 16) Poorly finished and unsightly verge fronting Abbeyleix Bog site. 17) Illegal dumping in entrances leading into woodland and bog.

Hence the development of the Biodiversity Action Plan for Abbeyleix (MacGowan *et al.* 2014.) This draft plan (as of June 2014) takes into account of environmental issues that beset the local community and provides a framework with which they can improve upon their built and natural environment. It includes 18 separate actions, some of which relate specifically to what is termed the southern gateway into the town. This is the area fronting Abbeyleix Bog. The actions recognise the value of the bog in the context of the wider landscape. The developments that are planned for roadside fronting Abbeyleix Bog are not about gentrifying or landscaping the bog and its important flora and fauna. Rather they are to improve upon the unsightly nature of the N77 road as it currently stands through sensitive planting with wildflower seed mixes and some native tree species and more appropriately incorporate the “southern gateway” and its biodiversity into the community (Photograph 16).

Recommendations

- Continue applying for DOE funding that encourages community groups enhance the areas landscapes
- Apply the actions outlined in Biodiversity Action Plan, in particular those associated with the Southern gateway e.g. Abbeyleix Bog as a priority so as to enhance visitor experience

6.6 Branding

The harnessing of a product/service into a coherent brand influences perceptions in people's minds. It is an attempt to unify the product/service and harness and influence the positive associations that the product or service is attempting to generate. Most branding experts consider that commercial organisations can greatly benefit greatly by creating a brand that sets the product or service apart.

With the continued development of the project, ABP Ltd. in cooperation with Abbeyleix Business and Community Forum Ltd. have started such an exercise. They developed a distinctive brand based on the iconic dragonfly logo seen at the front of this report as well as a cohesive set of guidelines for all publications/display format etc.

Branding however, is a far reaching tool especially given ABP Ltd's desire to increase the awareness of the site and its varied resources – current or planned. With this in mind consultation has been initiated with a number of agencies. A number of stakeholders raised the issue of widening the potential target audience and providing more (and readily available) information. This need not be as paper leaflets available on site, but could include more detailed or better publicised information in tourist information offices or hotels, as well as downloadable documents from the project website www.abbeyleixbog.ie or alternatively its Facebook page www.facebook.com/pages/abbeyleixbog/113923161953207.

Another aspect that encourages full exploration of the site is the signage. Consistency in design and display is essential, otherwise visitors are likely to be confused or ignore them completely. Signage should be clear, well maintained and ideally in a suitable type so that they are clearly readable by people with impaired vision.

Already a number of information boards (of varying state of maintenance) are present on the site. Other sign types include way mark pointers, though they are not consistent in design or material with the poster boards, having being installed by another agency. Stakeholders have suggested that excessive signage would greatly detract from the enjoyment of the site and potentially overwhelm visitors.

Where resources allow or new funding opportunities became available, the upkeep of the existing information boards should be carried out. Careful consideration should be given to the overall design and location of additional signs. Vulnerability to vandalism is a critical consideration in choice of material and method/site of display. Temporary signs,

except in the case of an emergency or event are to be avoided as they can detract from the aesthetic of the site and are a potential waste to be dealt with if damaged.

Recommendations

- Revisit all signage – make good repairs and reprint in current ABP Ltd branding style
- Initiate consultation with Looped Walk stakeholders about improving/consolidating waymark signs
- Consult with Laois Tourism about potential for revisiting the focus of its web content marketing the site
- Design a short web-printable document detailing site features such as history, culture, wildlife
- Continue hosting events and inviting specialists to hold events, lead tours etc. Advertising these events in various media outlets can focus the mind and interest in the brand

6.7 Accessibility and Facilities

At present entry to the site is via one main access point on the N77 road adjacent the Abbeyleix Manor Hotel, with a number of smaller entrance points along the North and North western perimeter. Currently the site is characterised by a single well-defined track that cuts through the middle of the site – the old railway line embankment. This forms part of the Killamuck Bog Loop which continues thereafter across, in places, boggy terrain. A second trail overlaps with a section of the Killamuck loop walk but this departs from the site crossing the N77 and continuing on elsewhere.

The introduction of phased sections of boardwalks (Figure 4) will greatly enhance the accessibility at the site. It will not be possible, however, to provide access for everyone to all parts of the site. A considerable part of the site is only suitable for able footed. The provision of services within this managed wildlife area must take cognisance of what can be reasonably expected in such an environment as is in keeping with International practice.

The relevant legislation relating to access for the disabled in Ireland refers only to the ‘built’ environment. Reference is not made to access to the ‘natural’ environment. However, the Equal Status Act, 2000, contains legislation against discrimination in the provision of services to the public on the grounds of disability. The Act imposes a duty on all service providers to ensure non-discrimination on the grounds of disability. As Abbeyleix Bog Project Ltd are in effect providing facilities at a site for the public to

enjoy, relax and interpret the wildlife, heritage etc., there is an obligation, to a degree to, provide access for disabled.

At present there is no Irish standard relating disability requirements for the outdoors (built or otherwise). The most appropriate standard that defines and guides the requirements or measures appropriate for most aspects concerning of access for disabled people is British Standard, BS8300: 2001.

Given the nature of the bog and woodland, it is neither reasonable nor practical to expect ABP Ltd to carry out improvements to all paths or boardwalks at any cost. Indeed the looped walks have been installed by Failte Ireland and managed by Irish Trail Network and any change or improvement would require consultation and approval. The provision of access to all areas within the site, as well as being prohibitive, will bring over-construction of measures and could impact the very attractiveness of the site for all users as well as wildlife. Thus for people with limited mobility, only a small part of the site notably the existing trail along the old railway track will be potentially suitable. The boardwalk itself, as currently designed, would not be ideal for people of limited mobility or capability unless accompanied by helpers.

The trail along the old railway track is in places heavily rutted and currently unsuitable for wheelchairs, most prams or those who are unsteady of foot. It will need to be upgraded (at least in places) to accommodate greater accessibility. There would appear to be two solutions that ABP Ltd could apply in fulfilling this objective, although expert opinion and a cost/benefit analysis by a suitable engineer is recommended.

1) The importation of hardcore/aggregate. It is however a potentially costly and time consuming solution and one which has some issues associated with it. The track would require grading in places, certainly at some of the potential turning points described in section 6.7. Could the flows in the interconnector drains between the East and West bogs be maintained? The hardcore would need to be levelled with appropriate machinery. Also, the sourcing and quality of the non-calcareous aggregate would have to be such that it was washed to minimise the release of fine sediment (that adheres to unwashed hardcore) entering into drains and potentially impacting the hydrological regimen maintaining the sensitive habitats (P. Kilfeather, Inland Fisheries Ireland & J. Ryan, NPWS).

More recently, the offer of Council road plainings has been made. Notwithstanding the attractiveness of the offer, concerns about its chemical composition need to be addressed as does the emplacement methodology as there is a potential for rainwater runoff carrying accumulated road chemicals/salts into drains or from physical slippage of material into drains creating blockages.

2) Scraping the mud to level the track may in the short term prove positive, but it is likely that rutting or deepening of muddied soil could recur. In addition, the organic soil that would be collected by whatever machinery available, would likely have to be brought off-site, itself a costly disposal issue and potentially one needing a waste licence.

The improvement of the main access track is for the benefit of potential visitors. But its maintenance would also serve another equally important purpose, namely as a dedicated access route for emergency vehicles (see section 6.7). The design of the access track surface would have to take into account widened turning points (A. Tynan, Laois Fire Officer, pers. comm.). There are a number of naturally occurring potential areas along the track. However, the advice of a suitably qualified engineer is recommended when developing this further as parts of the old railway track bed are visually insufficient to support the potential loading presented by emergency vehicles. These areas might require additional fill material.

It has also been suggested by some stakeholders of the possibility of allowing small minibuses catering for mobility impaired persons or small educational tours using the access trail. This issue has merits but ultimately is a matter for discussion among ABP Ltd, as it will have implications for opening gates, health and safety of other users, etc.

Along with improving upon the accessibility of the site, another complementary issue relates to the provision of rest points along the trail. This is standard practice in many recreational areas across the world including those managed in Ireland by agencies such as Coillte and BnM, etc. The siting and design of these resting structures should be in keeping with man-made structures already installed on site, but also of a quality and build so as to function properly and stand up to potential damage.

Finally, there is an unfortunate connection between improving the accessibility and unsocial activities, in particular, the problem of waste. While the main access point is gated, it is not always locked. A policy of restricting vehicular access should be more vigilantly adhered to. In regard of the smaller access points along the N77 Durrow road

and the L57332 Killamuck road these are largely freely ungated (Photograph 17). They are on land not owned by ABP Ltd, but are potential points of ingress for fly-tipping/dumping. There is a case for consultation with landowners and other stakeholders regarding the installation of proper barriers.

For visitors that are unfamiliar with the site, it is unfortunate that there is no dedicated parking area related to the site. Indeed there are no dedicated facilities such as education centre, toilets etc, present at Abbeyleix Bog. Unlike parking this is not of immediate concern, as it unlikely if any of this type of development would in the short term be planned for the site. As such the nearest facilities – parking, toilets, food are available in the adjacent Abbeyleix Manor Hotel. There is an informal understanding with the management of the hotel regarding the use of its car park at the end nearest to the entrance to the Bog. Ordinarily this has not been an issue except where large events hosted by the hotel rightly demand all of the car parking spaces (Ms J. Kent, Abbeyleix Manor Hotel pers. comm.).

In developing and promoting Abbeyleix Bog, however, there is the potential and desire to grow visitor numbers. For example, in developing the site for education purposes, there would be the need for larger coaches/buses to make use of the hotel car park. The Hotel management have indicated its continued support for the project. However, there are genuine concerns regarding liabilities etc. and ABP Ltd should enter into formal negotiations with the hotel management regarding a mutually beneficial agreement about the use of facilities.

Recommendations

- Prioritise the areas to be designated as accessible to as many users as possible.
- Employ a suitably qualified engineer to advise on options and to prepare a cost benefit analysis of regrading of track versus importation and levelling of hardcore
- In the absence of large scale improvement works, identify areas owing to neglect or damage that require repair so as to be suitable for emergency vehicles
- Identify suitable locations for turning points for emergency vehicles
- Identify areas that might be suitable for resting stations – benches or similar
- Investigate if improved barriers can be put in place at secondary access points to discourage unsocial activities
- Enter into discussions with Hotel Management regarding continued use of its facilities

6.8 Waste Arisings

A number of different waste streams and potential responses to how they are dealt with have been identified as part of the consultation process. Ideally, no waste should be generated by the site other than that arising as a result of maintenance operations. At present there are no litter or recycling bins provided on the site. Like the majority of outdoor sites that are provided for recreation purposes in Ireland, it is the responsibility of users to “Leave No Trace”. A brief description of the potential waste streams is presented.

Small scale waste – For the most part ABP Ltd do not have the resources to deal with recreationally produced waste. Indeed this ever-increasing waste stream can lead to environmental and unsightly degradation of sensitive habitats. Thus an obvious absence of bins. In practical terms, however, small scale waste will always be discarded on site. It should be dealt with by the project itself either in scheduled maintenance operations or an individual picking up another’s discarded rubbish. This may include the many middens – collections of old bottles that are often indicative of a particular person’s turf cutting area.

The current Local Authority waste management plan: www.laois.ie/EnvironmentandWater/WasteManagement/WasteManagementPlan highlights the onus on ABP Ltd to deal with all of its waste streams. Some limited council resources would be available including the provision of signage or other materials such as litter pickers, gloves etc. (Ms A. Chamberlain Laois Co. Co. pers. comm.). All waste however would have to be disposed of by a licenced collector (usually at the expense of ABP Ltd).

Illegal dumping or Fly-tipping – The IPCC suggest that the dumping of domestic or industrial waste on peatlands is indicative of a popular attitude that views these areas as wastelands; of little real value other than as dumping sites, particularly as they are often situated in sparsely populated or isolated areas (Malone & O’Connell 2009).

Whether adjacent to or inside the site boundary, the illegal dumping of material or fly-tipping it is a notifiable offence. Fly tipping complaints should be reported directly to the Environment Section on the litter hotline 1800 32 32 30. In instances, where evidence

can be retrieved by Litter Wardens, a direct prosecution under the Waste Management Act 1996 as opposed to the issuing of a litter fine may be sought.

In the event of hazardous waste being discovered, again the litter hotline should be notified. The onus, however, for its removal will be ABP Ltd and the council cannot provide assistance in this matter. It may require specialist protocol the deal with it.

Organic material – One of the main management objectives of the site will result in regular requirement to deal with vegetation. In the case of grass arisings etc, these should ideally be taken off-site and composted at a licenced facility. In this way, localised enrichment of the ground or drains will be avoided.

Of greater concern is the treatment of the Rhododendron waste that will be created each year. In the early years of this management plan there will be considerable volumes of wood created. At present, the felled woody material is left on-site. Best practice suggests that this is not ideal as it should be removed offsite and later burned (Section 6.9.4). The removal of other woody vegetation may be less problematical, and there may be some potential for recouping monetary gain for example through selling of firewood.

Another stream of organic waste that might be considered is that of soils. In the case where soils are removed e.g. scrapping of the railway embankment track to improve accessibility for emergency vehicles or small minibuses, than it should be disposed of off-site by a licenced contractor. There is little scope for the reuse of organic soils at the site, given the predominance of peaty substrates.

Invasive species – This stream is separated from organic matter for the simple reason that after habitat destruction, invasive non-native plant and animal species are generally considered to be the second greatest threat to biodiversity worldwide. There is a large number of potential and established non-native or alien species in Ireland. The establishment of any single species at Abbeyleix bog is a situation which nobody desires. Identification fact sheets are freely available on www.invasivespeciesireland.com.

Codes of practice have been developed for a number of different industry sectors (those of which are considered the greatest locus for all invasions). Abbeyleix Bog and its woodland does not fall under those categories, but it is prone to a number of different vector pathways leading to the establishment of undesirable species. The use, where necessary, of machinery (including large plant) for any operation onsite should be cleaned and sterilised prior to being brought on site. The origin of newly planted stock, either

within the site or its immediate boundaries, should be of proven quality from a reputable local source. In this way the spread on unwanted plant and some animal species can be minimised.

There is no practical solution for mobile mammals and other smaller invertebrates that might arrive of their own volition at the site, nor errant plant material from outside of the site. There is no practical solution for screening, for seed material, the footwear and clothing of every visitor accessing the site. Vigilance is the keyword and contact details prominently displayed on appropriate noticeboards so that ABP Ltd may be notified of a potential problem.

Recommendations

- Treatment of various waste should be done in accordance with national legislation and in particular the Local Authority Waste Management Plan
- ABP Ltd should contact Laois County Council for a supply of equipment to facilitate litter picking
- Dumping of any nature should be notified in confidence to the Local Authority Litter Hotline 1800 32 32 30
- Develop a protocol to be initiated upon discovery of illegal dumping or hazardous waste; or for treating spillages (accidental or otherwise) of contaminants on site
- Phased cutting of verges (in consultation with Butterfly surveyors) and removal offsite of biomass
- In the event of machinery or plant coming on site, they should be washed with suitable decontaminant such as phosphoric acid to minimise establishment of invasive species by seed

6.9 Health and Safety

This section is a summary of the legislative requirements regarding Safety, Health and Welfare. It does not purport to be comprehensive and the services of a “competent person” as defined under legislation should be engaged to develop this area this further.

6.9.1 Workplace Environment

The Safety, Health and Welfare at Work Act 2005 states that employers must ‘ensure, so far as is reasonably practicable, the safety, health and welfare at work of his or her employees’. The person in control to any extent of the workplace should ensure a safe workplace, safe access, safe egress and safe articles or substances. In addition to occupational safety and health legislation, there is also a significant body of other legislation governing health and Safety in non-work and occupational situations.

Although largely voluntary in nature and management, ABP Ltd should be cognisant of the act in so far as they exercise a duty of care to potential employees. There are obligations on landlord's who own (but are otherwise unconnected) with a workplace to ensure that there is safe access and egress from the place of work. To this effect, ABP Ltd should carry out and record all risk assessments in a Safety Statement as developed by a "competent person".

It is a requirement of most current operations/developments/ amenities that insurance be held and that a health and safety plan be prepared and regularly reviewed, particularly where new operations or events are planned.

There are no specific legal provisions in Irish law in relation to the insurance of volunteers while "on the job". Volunteering Ireland (www.volunteeringireland.com/) however recommends that organizations that involve volunteers develop written policies that state clearly, among other things, that volunteers are insured against risks of illness, accident and third party liability. Where an organisation does or cannot offer this option, than volunteers should provide for their own personal safety and security. Full-time volunteers should ensure that the volunteer programme offers adequate protection in this regard, for example the European Voluntary Service Programme provides each individual volunteer with an insurance plan.

6.9.2 Safe working procedures in forestry operations

In dealing with the problem of invasive Rhododendron and trees on the high bog as well as well as overhanging/fallen trees along public tracks, ABP Ltd, must follow the HSA (2009) guidance "Code of Practice for managing safety and health in forestry operations". Prior to any works the sequence of events is as follows:

- Preparation written risk assessments
- The selection of suitable equipment for the job
- Protecting health and safety – both for workers, voluntary staff and the public
- Ensuring the safe working procedures are in place
- Supervision and monitoring of the work by a competent person

The above sequence is time consuming and puts considerable responsibility on ABP Ltd. For this reason, it cannot be understated that the management of woody vegetation invasive or otherwise at Abbeyleix bog will take some considerable time and it is unlikely that it can be tackled in the timeframe of this first conservation management plan. Consideration should be given to contracting professional assistance for large areas.

The use of chainsaws, in particular, is problematical particularly given the size, nature and volume of rhododendron and trees that need to be removed. The HSA has issued guidance for their use entitled “Guide to safe working with timber and chainsaws”. Furthermore it is recommended that if chainsaws be used, then the operator be certified to the industry standard City and Guilds NPTC standard, of which there are several different categories depending on the exact nature of the work.

6.9.3 Response to Damage or Injury

Given the nature of the site - outdoor, uneven terrain etc, and despite planning/installing/managing the site negate against such incidents, the threat of an accident, however minor is always possible. In the case where there is a need for First Aid or the services of an ambulance, these are usually directly requested by the injured party or somebody accompanying them. However, for events organised by ABP Ltd, the provision of volunteers with First Aid experience is desirable as is a note on the information boards indicating location of nearest first aid box.

6.9.4 Fire Threat

The threat of fire within fragile ecosystems such as bogs and forestry is ever present and can be devastating. Peatland wildfires are considered extreme events that are becoming more frequent both in Ireland and internationally (Prat *et al.* In Press). Historically, the high risk period usually extends from April to June, although fires have occurred between July and August in Laois (Article in Laois Nationalist March 6th 2014), as suitably dry periods can result in ignition. Of real concern in relation to fire is that smouldering or subsurface combustion, unlike visible flames and smoke is difficult to spot as it occurs hidden from view underground within the organic layer and can go unnoticed for months. Indeed subsurface fires can be significantly more extensive than might be expected (Rein *et al.* 2008).

Abbeyleix Bog has experienced its own share of fires as evidenced as recently as August 2013. Fortuitously spotted, the threat was quickly extinguished. There is evidence of lightning strikes and charring elsewhere in the site such as around the lagg. While the source (accidental or otherwise) of peatland fires cannot always be definitely established, the devastation that they bring upon the habitats and its wildlife assemblage is certain. No conclusive causal agent was ever assigned to the 2013 fire at Abbeyleix bog. Increased human activity, in addition to the widely accepted impacts of climate change, has from experience elsewhere in the county increased the likelihood peatlands becoming susceptible to fires. (A. Tynan. Laois Assistant Chief Fire Officer. pers. comm.).

In preparing the brief recommendations, Laois County Councils' Fire Plan Guidance Notes (version 2011) were reviewed. The template plan, once completed contains all of the essential information required for an efficient response to a wildfire. However, it must be stressed that this is a template that needs to be completed by appropriate personnel in conjunction with the Fire Service.

Recommendations

- Signage on site should be provided indicating location of nearest first aid equipment, Defibrillator etc.
- Consult with Local Fire Authority and HSE Ambulance department regarding access requirements – loading weights and maintenance design of access track, design of suitable turning points
- Develop a fire plan in conjunction with a “competent Person” and Local Fire Authority to include chain of command regarding reporting, site specific map breaking the bog into defined areas that is easily relayed to responding emergency personnel equipment requirements such as specific tenders and tankers or the type of hose to be used
- ABP Ltd should become a member of Laois Wildfire Liaison Group
- Consider training for ABP Ltd volunteers that may be tasked with assisting with a major incident – First Aid training, Manual handling, Voluntary assistance during fires

6.10 Unsocial Activities

As with any easily accessible and isolated site the potential for unsocial and or damaging activity is ever present. The list of activities that could be included under this heading is relatively large: They are listed in no particular order:

- Loitering
- Damage to property
- Illegal activities as defined under the Wildlife Act 1976 as amended 2000
- Illegal dumping
- Interference with or unruly behaviour towards others
- Dogs or other animals not under effective control of owner as provided for under legislation

There is a voluntary wardenship scheme at Abbeyleix Bog. It is not realistic to have a presence onsite at all times, nor is it desirable for volunteers to tackle the public or other suspected villainous types except in a conciliatory manner. In the case of confirmed delinquency or intimidation/danger to others, the services of An Garda Síochána should be sought.

Recommendations

- Develop a unified procedure for volunteers/wardens to notify Garda Síochána if any untoward/threatening behaviour encountered or illegal incident evidenced
- Immediately notify Emergency services of threat/injury to person(s) or fire
- Notify National Parks and Wildlife Service (Local Office) regarding illegal activity/interference to wildlife and mammals, birds (and plants to a lesser degree)

6.11 The Planning Process

At present, many of the planned management operations for the site would be exempt from planning process. However, in the event of there being a proposal e.g. to construct a permanent facility within the site, it would likely be subject to the normal planning process. In certain instances, such as where planning permission is being sought, it is necessary that any proposal has regard to Articles of the European Union (EU) Habitat (92/43/EEC) and the EU Birds Directive (79/409/EEC) as amended and transposed into law in Ireland primarily by the Planning and Development (Amendment) Act 2010 (as amended) and the European Communities (Birds and Habitats Regulations, 2011 (SI No 477 of 2011) (as amended).

In this regard due consideration of the possible nature conservation implications arising as a result of any plan or project on the NATURA 2000 site network. Importantly for Abbeyleix, this would include sites not occurring within the Site of conservation importance but having a demonstrable link and whose projects/plans would not be to the management of the site of conservation but likely to have significant effects thereon. Abbeyleix Bog, although undesignated, has a physical linkage with the River Barrow and

River Nore candidate Special Area of Conservation (cSAC 002162). It has many features of conservation note notably, as an important salmonid nursery; and the only site supporting the Nore Pearl mussel, (*Margaritifera margaritifera durrovensis*). NPWS would have statutory concerns regarding potential disturbance to wildlife or damaging impacts to habitats, whilst the primary concern of Inland Fisheries Ireland would be the avoidance of deleterious matter being discharged into a watercourse and potentially arriving into the River Nore or Owenbeg River. Therefore it is likely that some projects that might be planned for the future could not proceed without a Natura Impact Statement being carried out as part of the planning process. Any plan would require the provision of adequate facilities for the potential collection and disposal of sewage waste, and that if designed and built to a suitable standard, would not anticipate any difficulty from Inland Fisheries Ireland in the planning process (P. Kilfeather, IFI Senior Environmental Officer. pers. comm.).

If as is expected, the site is designated in the near future, there may be some additional implications for the site in terms of planning and management, but likely nothing that has not already been highlighted or recommended given the considerable consultative input of NPWS personnel and others in their capacity as members of the projects TAG committee. The potential designation of the site as a NHA would result in the statutory implementation of a conservation plan by 2017. Similar to other plans that have already been developed by NPWS for sites of conservation importance, it would primarily focus on the maintaining or improving upon the condition and extent of the habitats (and species) particularly raised bog habitats, to satisfy the national attainment of stated conservation obligations (Anon 2014c).

The potential designation of the site as a Special Area of Conservation (SAC) or Special Protection Area (SPA) would bring additional obligations and some potential curtailments of the management regime. These obligations would be notified to the Abbeyleix Bog Project Ltd as part of a detailed consultation process initiated by NPWS.

Notwithstanding any future designation that might apply to Abbeyleix Bog, the regulations of the Wildlife Act (1976) as amended (2000) would apply to certain species; including plants listed in the Flora Protection Order 1999 or mammals as described in the Irish legislation.

6.12 Other Issues

The extent of the bog is constrained by its immediate neighbours, and most stakeholders were invited to consult during the preparation of the CMP.

The expansion of the quarry/precast facility has had some discernible impact on an adjacent stream that leads into the highly sensitive lagg. If unchecked this will have obvious implications for any conservation management efforts at this site, particularly given the national scarcity of this habitat type. Consultation should be entered into with the operators of the licenced Quarry and the Local Authority with regards the seepage of silt from spoil into a peripheral stream within the Bog (Photograph 18). As part of the dialogue, ABP Ltd. could assist in development of an ecologically sound remediation program that might be put in place. There would be a need for a hydrological survey to ascertain the water movements into and potentially out of (through for example drawdown in a quarry well) on the lagg.



Photograph 18: View of Quarry spoil heap adjacent to principle lagg area on eastern side of Abbeyleix Bog. During wet periods, sediment readily flows into the clogged stream at the toe of the slope (within the Abbeyleix Bog).

Abbeyleix Game Club have made representations regarding the potential management of vermin species on the site, notably the invasive American Mink. Whether released by accident or by malicious intent, this species readily adapts, quickly establishing itself at

the top of the food chain. In Ireland, they are regarded as a pest species, and a problem that has not gone unnoticed in the wider Abbeyleix area given the apparent decline in management/commercial shooting (D. Hogan, pers. comm.). The Game club, while not currently using Abbeyleix Bog as a shoot, are keen to offer their services as in terms of managing the mink. Consultation should continue with Game Club to discuss these issues, in light of the conservation objectives of this wildlife sanctuary and particularly given that an unknown person(s) has, at least in the past, been shooting on the bog as evidenced by spent cartridges across the site.

Much of the land immediately surrounding the Bog (and separate from the lease currently held by ABP Ltd.) is currently given over to plantation forestry by a private landowner. It is nearing commercial maturity and a felling licence has been or will be applied for. In terms of potential restoration of the wider bog mosaic, the management of the plantation would have the potential to complement the conservation objectives of Abbeyleix Bog. The most extensive area of applicable cutover for rewetting occurs along the western periphery, where much of the forestry is located.

At present, it provides cover for predators, serves as a repository for continued encroachment of coniferous and invasive species across the bog and is not ecologically complementary to the bog given the preponderance of non-native species.

The acquisition of this additional land, with the agreement of the landowner, would be a strategic decision that ABP Ltd. might consider. In the absence of acquiring all or part of the land, then negotiations should be entered into regarding the replanting strategy for the site. The benefits of native species, rather than introduced conifers, re-establishing over a long time period could in time reflect natural habitats reminiscent of the area.

Recommendations

- Active engagement with Quarry operator to highlight potential and actual damage to bog and water-dependant habitats
- Carry out hydrological study of water movements into and out of the affected area
- Assist in development of potential rehabilitation plan
- Continue consultation with Abbeyleix Game Club
- Enter into dialogue with owner of afforested land with a view to acquiring part or all of the land to consolidate the conservation objectives of the site and or agreeing to an alteration of the management regime to further increase the restoration potential of bog habitats

7 CATALOGUE RAISONNÉ OF RECOMMENDATIONS

In preparing the CMP for Abbeyleix Bog, the objectives outlined in the tender brief were considerable; and the list of recommendations that follows is substantial. For ease of navigation, all of the recommendations are presented together under their various headings.

It is clear that some of the recommendations are repetitive. This is unavoidable, particularly across a range of different habitats. And despite the comprehensive information that has already been garnered for the site, it is clear that there are shortcomings in the data. Often a recommendation calls for further research or survey. This is certainly true about the habitats, many of which would greatly benefit from detailed characterisation and mapping.

It is for this reason that the recommendations have not been prioritised. That task falls to the volunteers of ABP Ltd. It is, after all, only they that can make the final decision on the practicalities on what is achievable by themselves and on more onerous objectives that will require assistance or funding from partners, whether they be volunteers or statutory bodies charged with National conservation objectives.

Raised Bog

- Repeat the ecotope survey of the High bog, every 5-10 years to gauge the efficacy of restoration policy and ascertain the extent of potential (favourable) habitat gain
- Prioritise areas of high bog where tree and scrub colonisation are impacting habitat & instigate plan for their removal
- Finalise the hydrological restoration plan and prioritise the areas identified in Map 4, Appendix 3 which would benefit from additional management

Cutover Bog

- Finalise the hydrological restoration plan and identify areas of cutover which would potentially increase the restoration possibilities for regenerating raised bog habitat. benefit from additional management
- Survey cutover to establish baseline condition and character of mosaic communities prior to any rewetting

Lagg

- The intricate mosaic including Annex I habitats would benefit from further survey and delineation of the various habitats therein
- Engage a hydrological expert to consult on the hydrological issues surrounding this issue
- Instigate consultation with Quarry regarding potential for remediation

Wet Woodlands and Other Woodlands

- Undertake a survey to characterise and map the current boundaries of all of the various woodland habitats, particularly the potential Annex I Bog Woodland
- Establish a regular monitoring programme for highlight areas where seedling reestablishment occurs
- Look into Native Woodland scheme for funding towards areas of natural regeneration

Scrub

- As the bird nesting season runs from the 1st March to the 31st September, the cutting of trees, bushes and hedgerows should be prohibited during this period.
- To facilitate wildlife resource, the large scale removal of native scrub should not be carried out except where it occurs on high bog and in those areas considered problematic or incompatible with the objectives of other habitats considered of more pressing concern or priority
- The removal of non-native species should be prioritised and appropriately managed

Grasslands

- Ensure that any verge maintenance is carried out in sections rather than as single swathe so as to negate disturbance for wildlife
- Discourage the picking of colourful flowers – a) they may be host or food source for butterflies & b) they may be very restricted in their distribution at Abbeyleix Bog e.g. Orchids.

Water Features

- Ensure that all operations carried out during the management of the site do not alter linkages between the drains and smaller streams within the woodland areas potentially impacting with downstream areas and its wildlife concerns e.g. River Nore SAC
- Commission a survey to map out the course of all watercourses entering or weaving through the site as part of a greater understanding of the hydrological influences on the habitats
- The negative influence of silt-laden water from the Quarry spoil heap on the lagg area should urgently addressed through consultation and the design and implementation of a remediation plan

Disturbed Ground and Minor Habitats

- The importation of aggregate or clearance of material from the access trail should be stockpiled in appropriate areas so as not to impact with existing vegetation and impact feeding sites for birds, bees and butterflies
- Monitor the spread of bracken in drier areas and manage appropriately where necessary

Plants

- Monitor management procedures and refine as necessary those that may impact the flora to the (short-term) detriment of other species such as butterflies
- Consider installing exclosures to monitor efficacy of vegetation clearance or to exclude deer
- Be vigilant for arrival of all invasive species, not just Rhododendron, from adjacent landholdings, either by natural vectors or through use of equipment/machinery brought from other sites
- Map orchid-rich areas and monitor for changes due to pedestrian damage or other impacts

Mammals

- Maintain a database whereby records are easily inputted by all
- Partner with IWT to plan surveys of outstanding knowledge deficits
- Invite a bat group (accompanied by ABP volunteer for local knowledge of terrain) to carry out a bat survey of different areas of the site
- Do not carry out major operations – treefelling, without determining Potential Bat Roosts or as nesting sites for birds. All operations must be done in the appropriate season (March 1st-August 31st) as dictated by Irish Wildlife legislation

Birds

- As birds are readily monitored indicator species of a sites and its habitats health, the project should implement a structured bird monitoring regime that should include a Breeding Bird Survey, Colony Census and ideally, a breeding raptor census.
- Develop and populate database - Abbeyleix Bog Project Ltd should register an account with an online recording application to facilitate volunteers uploading records. This could later facilitate data input into the National Biodiversity Data Centre database
- Habitat management e.g. verge maintenance, tree removal should be carried out in the winter season between 31st August and March 1st to avoid disturbance to breeding species. Ideally, no large scale removal in any one place be carried out
- Consideration might be given to the possible retention of some standing dead on peripheral parts of the high bog and in developing wet woodland
- Identify areas of high conservation value where activities management, minor development or unnecessary disturbance from visitors be prohibited
- Define target species which might over time be naturally enticed to breed on site e.g, Snipe.
- As a further educational resource, consider provide bird boxes in visible places or where large numbers of trees removed so that impact is lessened and also to potentially improve viewing potential for visitors

Amphibians & Reptiles

- Monitor areas of known spawn/frog congregation for impacts due to changes in hydrology or from other impacts from management operations such as periodic verge cutting in wet areas along the tracks
- Ensure and educate people that no collection of spawn be allowed except under licence (N.B. Open licence for schools with restrictions)
- Instigate IPCC's Hop to it Frog Survey to broaden the understanding and extent on site
- Develop a family based event based on IWT's recently finished newt recording scheme to try and confirm newts

Spiders

- Engage with Mr Myles Nolan regarding potential application of predictive approach using Abbeyleix as a test model to monitor spider species

Butterflies and Moths

- Prepare a detailed map of the monitoring transect – allows for continuity so that new personnel can continue monitoring where necessary
- The management of the site, in particular large-scale vegetation removal/clearance must take cognisance of the potential impacts on butterfly diversity
- Alongside the scheduled butterfly monitoring, encourage family participation in Dublin Naturalists Field Club Butterfly Recording Scheme and for the National Biodiversity Data Centre
- Implement a modified survey and recording technique for Marsh Fritillary

Insects

- Continue collecting records, pictures or specimens (if dead) about insects
- Encourage seasonal events, family or otherwise, for seasonal preference for collecting specimens
- Develop partnerships with experts so that difficult finds can be identified
- Encourage events to be held on the site such as IWT's Ladybirds recording schemes

Molluscs

- Further reconnoitring of suitable habitats within the site may reveal more species

Fish

- Monitor the Brook lamprey population and recommend that the site be included in any future Lamprey survey of the wider Nore catchment, particularly in light of potential siltation from plantation clearance or nutrient enrichment from adjacent agricultural land
- Ensure that in the course of any operation including installation of peat dams, that the importation or introduction of non-native species not be allowed into watercourses within the bog system

Hydrological Management of the Bog

- Refine rewetting plan for Abbeyleix Bog so that future restoration works be carried out on a phased basis to lower potential impacts
- Initiate detailed consultation, in conjunction with partners such as NPWS, with landowners and other stakeholders
- Recommend that no additional restoration works such as drain-blocking be carried out where there is potential to impact on adjacent land-owners or impact on other objectives of the CMP such as maintenance of looped walks
- Redo ecotope survey in the near future and at regular periods thereafter to monitor the efficacy of hydrological management and success of potential restoration

Vegetation Removal

- Develop a site specific method statement to tackle tree removal
- Prioritise areas to be tackled both on the high bog for removal of all trees (where deemed problematical) and cutover areas.
- Important to retain all trees in extant areas deemed as Bog Woodland or cutover areas with potential to develop into Bog Woodland Retain all trees in areas deemed to be Bog woodland
- Establish a programme to monitor new recruitment or reestablishment of trees

Verge and Bog Maintenance

- Survey and map the entire site for presence of Rhododendron – Repeat regularly while rhododendron still present on site or adjacent land
- Prioritise areas to be tackled (will involve consultation with local landowners)
- Develop a site specific plan to deal with removal of material
- Conduct follow up surveys of cleared areas
- Consideration should be given to contracting professional assistance for large areas
- Prioritise areas on high bog for removal of all other tree species
- Remove as many as is a practicable

Walking Routes

- Continue funding drive to enable boardwalk to be finished
- Monitor usage to see where potential issues arise e.g. slippage, handrails
- Discourage visitors straying off boardwalk into potentially sensitive nesting areas
- Consult Irish Trail Network regarding upkeep of derelict/impassable sections of the existing Looped walks

Education

- Develop awareness of the site as an educational resource – market the site among schools etc., for guided or self-guided coursework
- Map and design a “wildlife orienteering course” with suitable stops for different educational needs.
- Prepare digital information packs that can be downloaded by schools

- Identify outstanding knowledge deficiencies for the site and develop a work schedule regarding particular species/habitats

Integration into the wider Community

- Continue applying for all relevant funding that encourages community groups to enhance their areas landscape
- Apply the actions outlined in Biodiversity Action Plan, in particular those associated with the Southern gateway e.g. Abbeyleix Bog as a priority so as to enhance visitor experience

Branding

- Revisit all signage – make good repairs and reprint in current ABP Ltd branding style
- Initiate consultation with Looped Walk stakeholders about improving/consolidating waymark signs
- Consult with Laois Tourism about potential for revisiting the focus of its web content marketing the site
- Design a short web-printable document detailing site features such as history, culture, wildlife
- Continue hosting events and inviting specialists to hold events, lead tours etc. Advertising these events in various media outlets can focus the mind and interest in the brand

Accessibility

- Prioritise the areas to be designated as accessible to as many users as possible.
- Employ a suitably qualified engineer to advise on options and to prepare a cost benefit analysis of regrading of track versus importation and levelling of hardcore
- In the absence of large scale improvement works, identify areas owing to neglect or damage that require repair so as to be suitable for emergency vehicles
- Identify suitable locations for turning points for emergency vehicles
- Identify areas that might be suitable for resting stations – benches or similar
- Investigate if improved barriers can be put in place at secondary access points to discourage unsocial activities
- Enter into discussions with Hotel Management regarding continued use of its facilities

Tackling Waste

- Treatment of various waste should be done in accordance with national legislation and in particular the Local Authority Waste Management Plan
- ABP Ltd should contact Laois County Council for a supply of equipment to facilitate litter picking
- Dumping of any nature should be notified in confidence to the Local Authority Litter Hotline 1800 32 32 30
- Develop a protocol to be initiated upon discovery of illegal dumping or hazardous waste; or for treating spillages (accidental or otherwise) of contaminants on site
- Phased cutting of verges (in consultation with Butterfly surveyors) and removal offsite of biomass

- In the event of machinery or plant coming on site, they should be washed with suitable decontaminant such as phosphoric acid to minimise establishment of invasive species by seed

Health and Safety

- Signage on site should be provided indicating location of nearest first aid equipment, Defibrillator etc.
- Consult with Local Fire Authority and HSE Ambulance department regarding access requirements – loading weights and maintenance design of access track, design of suitable turning points
- Develop a fire plan in conjunction with a “competent Person” and Local Fire Authority to include chain of command regarding reporting, site specific map breaking the bog into defined areas that is easily relayed to responding emergency personnel equipment requirements such as specific tenders and tankers or the type of hose to be used
- ABP Ltd should become a member of Laois Wildfire Liaison Group
- Consider training for ABP Ltd volunteers that may be tasked with assisting with a major incident – First Aid training, Manual handling, Voluntary assistance during fires

Unsocial Activities

- Develop a unified procedure for volunteers/wardens to notify Garda Síochána if any untoward/threatening behaviour encountered or illegal incident evidenced
- Immediately notify Emergency services of threat/injury to person(s) or fire
- Notify National Parks and Wildlife Service (Local Office) regarding illegal activity/interference to wildlife and mammals, birds (and plants to a lesser degree)

The Planning Process and Other Issues

- Active engagement with Quarry operator to highlight potential and actual damage to bog and water-dependant habitats
- Carry out hydrological study of water movements into and out of the affected area
- Assist in development of potential rehabilitation plan
- Continue consultation with Abbeyleix Game Club
- Enter into dialogue with owner of afforested land with a view to acquiring part or all of the land to consolidate the conservation objectives of the site and or agreeing to an alteration of the management regime to further increase the restoration potential of the bog habitats

8 CONCLUDING REMARKS

The full value of Abbeyleix Bog was not fully realised until the 1980's when BnM commenced draining the site. The Bog has an enthusiastic and growing band of supporters who are keen for the site to become a real treat for the local community and others from further afield. With the introduction of the looped walks and the first section of the boardwalk across the high bog having been completed, new vistas and delights await visitors.

There is a growing realisation that raised bog ecosystems are unique and irreplaceable. In terms of its wildlife – habitats and species assemblages, Abbeyleix, unlike many other bog sites has a wealth of diversity for all to enjoy and learn from. It is fortunate that domestic peat cutting is not carried out at Abbeyleix Bog. The development of the boardwalk and the juxtaposition of many habitats presents considerable opportunities for further study; or merely enjoyment as happens on guided walks and events that are staged there.

In preparing the CMP, one is mindful that the project is a voluntarily-run community-based initiative. Other than the goodwill of volunteers, many of the practical aspects of the plan will be constrained by financing. The economic downturn means that securing funding for projects is hugely competitive across all areas of society. Abbeyleix Bog Project represents an important contribution towards the conservation of a precious resource and a potential model by which other interested local communities might develop and progress similar projects.

Community groups such as Abbeyleix Bog project Ltd need to be creative about how and where they source funding for their projects. It is likely that the hunt for funds will be an ongoing task for the project personnel. As a result groups need to be experienced at presenting, promoting and marketing of projects to potential funders in both the public and private sectors. Some basic recommendations in preparing funding applications are detailed in the Heritage Council's 2012 publication entitled "Community-led Village Design Statement (VDS) Toolkit"

It is beyond the scope of the management plan to identify all potential funding streams. Indeed it is a role that could take up a considerable amount of time for a suitable individual. Already numerous funding schemes/agencies have been approached by Abbeyleix Bog Project Ltd and detailed funding submissions prepared. The success to date in sourcing funding as well as winning several commendations is testament to the

determination of the committee and has enabled the project to proceed with a start being made on some of the management objectives.

A number of small-scale possibilities in furthering the conservation objectives as well as generating direct income might be considered by ABP Ltd. In suggesting these options, however, the feasibility in terms of resources or development of a business plan is not addressed.

- 1) The disposal of wood, removed over time from the bog, could be problematical. Only a small portion might be reused onsite such as drain blocking. Options for the remaining wood include chipping for sale or the development of a small charcoal industry. Both options would need to be done offsite.
- 2) Regeneration of trees – Pines, Birch and Willow will continue beyond the duration of this CMP. Small saplings could be harvested and used to provide some income as nursery material. Alternatively they could be given to locals for use in schools or homes. Indeed, it is an opportunity to involve the community or school groups in assisting in achieving some of the conservation objectives.
- 3) Although the project objectives aim to realise a definite amenity and educational resource, there are areas where activities or disturbances should not be encouraged. This is to negate unnecessary disturbances on wildlife as well as for health and safety concerns such as deep water-filled drains and uneven terrain. There is considerable potential and undisturbed territory at Abbeyleix Bog e.g. the Eastern part of the site for maintaining hives with a view to producing honey. Such an endeavour would certainly require mentoring (such as might be available from the local Dunamais Beekeepers Association) and specialist kit, information about which is freely available on www.irishbeekeeping.ie

On a larger scale, some novel funding approaches have been developed, or are in early stages of development, in other countries. Although they are open to interested individuals interested in supporting environmental issues, they are in reality aimed at company sponsorship motivated by corporate social responsibility (CSR). Two examples are presented for comparison.

Recently developed by the IUCN UK Peatland Programme to promote peatland restoration in the UK, the Peatland Code is the voluntary standard for restoration projects in the UK that want to be sponsored on the basis of their climate and other benefits. At this early stage, the pilot code is designed to facilitate business sponsorship

motivated by corporate social responsibility (CSR) and is aimed at specific pilot projects undertaking peatland restoration. There is, as yet no comparative scheme in Ireland, other than possibly the Irish Forestry Funds scheme (www.irish-forestry.ie) was instigated to facilitate investment in Irish forestry as an asset, rather than for conservation purposes.

Another scheme with potential benefit for Abbeyleix has been running a little longer in Germany. It is recognised that natural peatlands play a major role in regulating the global climate by actively removing carbon dioxide (CO₂) from the atmosphere and storing C within the peat (Frolking & Roulet 2007, Dise 2009, Wilson *et al.* 2013). It was this rationale that has led to the development of the German Moorfutures 2.0 scheme (www.moorfutures.de/en/moorfutures/what-are-moorfutures).

Established initially as a means for long term funding (30years +) towards the restoration of totally degraded bogs sites through offsetting carbon, the backers are currently examining ways to incorporate methods for funding biodiversity projects also. The sponsors of the scheme are thought to be interested in widening the scope of the project and exploring new territories such as degraded peatlands in Ireland (D. Wilson pers. comm.). And while there remain many uncertainties, given the relative dearth of real data from Ireland (Wilson *et al.* 2013) as to potential for effective Carbon sequestration in damaged peatland sites, the potential exists for the Abbeyleix project to proceed along this novel route as the prospective test case for innovative scheme towards funding bog rehabilitation in Ireland.

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APPENDICES

Appendix 1: List of Consultees and response

Appendix 2: Consolidated List of Flora and Fauna from Abbeyleix Bog

Appendix 3: Individually themed Indicative models whose data when taken in conjunction suggests high potential restoration possibilities on Abbeyleix Bog

Appendix 4: Methodology for Predictive Arachnid Sampling

Appendix 1: List of Stakeholders and indication if response received

Contact	Organisation	Consultation Method	Response Received
Mr Brian Maher	Chair Abbeyleix Business & Community Forum	Telephone	Telephone
Ms Fiona Dunne	Department of Education Policy	Email formal letter	Initial email, awaiting full response
Mr Ross Irvine	Estate Manager AbbeyLeix Estate.	Email formal letter	---
Ms Jenny Kent	Abbeyleix Manor Hotel.	Email formal letter	Email and Telephone
Ricky Whelan	Chair, Laois Offaly Branch of IWT	Email formal letter	Email
The Viscount de Vesci	Local Landowner	Email formal letter; Telephone	Email and Telephone
Ms Maria Walsh	National Biodiversity Data Centre.	Email formal letter & Email	Email
Dr David Wilson	Earthy Matters Environmental Consultants	Email and Telephone	Email and Telephone
Mr Aidan McEvoy	Principal, Scoil Mhuire National School, Abbeyleix.	Email formal letter	---
Mr Philip Bowe	Principal, Heywood Community School, Ballinakill.	Email formal letter	---
Mr Dehon Hogan	Abbeyleix Game Conservation Club	Email formal letter	Telephone, awaiting formal email response
Mr Peter Booth	Booth Quarries	Telephone	---
Mr Tom Kelly	Local landowner	Telephone	---
Ms Mary White	Abbeyleix Tidy Towns Committee	Email formal letter	Email
Mr Patrick Kilfeather	Senior Inspector, Inland Fisheries Ireland.	Email formal letter	Email detailed response
Mrs Wallace	Principal, Abbeyleix South National School.	Email formal letter	---
Faite Ireland		http://www.discoverireland.ie/Contact-Us/Consumer-Enquiry?	---
Laois Tourism	Laois Tourism	Email formal letter	---

Mr John Maher & Mr Alec Silke	Birdwatch Ireland Laois Branch	Email formal letter	Email
Dr Alex Copland	Birdwatch Ireland Senior Conservation Officer	Email formal letter	Email
Dr Emma Seale	Laois County Council Environmental Intern	Email and Telephone	Email and Discussion
Catherine Casey	Laois County Council Heritage Officer	Email formal letter	Email
Dr Mark McCorry	Bord na Mona Ecologist	Email and Telephone	Email
Mr Tadhg Ó Corcora	Conservation Officer, Irish Peatland Conservancy Council	Email formal letter	Email and Discussion
Ms Nuala Madigan	Environmental Education Officer, Irish Peatland Conservancy Council	Email formal letter	Email
Dr Catherine Farrell	Bord na Móna	Email	Email
Jim Ryan	Wetlands Ecologist, National Parks and Wildlife Service Research Branch	Email	Email and Telephone
Mr Myles Nolan	Natural History Museum Merrion Street, Dublin 2.	Email	Email
Mr Fernando Fernandez	Ecologist, National Parks and Wildlife Service Research Branch	Email	Email and Telephone
Ms Clare Coffey & Ms Annemarieke van der Voort	Butterfly Monitoring Volunteers	Email formal letter	Email
Dr. Tomás Murray	National Biodiversity Data Centre	Email	Email
Mr Anthony Tynan	Assistant Chief Fire Officer, Laois County Council	Telephone	Telephone and Email
Ms Ciara Flynn	District Conservation Officer, National Parks and Wildlife Service, Kildare Office	Formal Letter	---
Dr John Conaghan & Mr John Derwin	Consultant Ecologists - Coillte-LIFE bog restoration project	Email	Email
Ms A. Chamberlain	Waste Enforcement Section, Laois County Council	Email formal letter	Email
Mr D. Kiely	Planning Section, Laois County Council	Email formal letter	---

Appendix 2: Consolidated List of Known Flora and Fauna from Abbeyleix Bog

This list is based upon documented records in reports or specialists, as well as the many individuals who partook in the 2013 Bioblitz event. The scientific name is followed by the common name and where data exists, the range of habitats in which a species occurs or the year that a particular species was first noted. That the list is incomplete or has absences is a reflection of the diversity that still awaits to be discovered from Abbeyleix Bog.

HIGHER PLANTS

<i>Acer pseudoplatanus</i>	Sycamore	WD1/GS/FW4/PB4/WN7/WN2
<i>Achillea millefolium</i>	Yarrow	WD1/WS1/GS/PB4/WN6/WN7
<i>Aegopodium podagraria</i>	Ground-elder	PB1/WN6/WN7/WN2
<i>Aesculus hippocastanum</i>	Horse-chestnut	WD1/GS/FW4/PB4/WN7/WN2/PB1
<i>Agrostis stolonifera</i>	Creeping Bent	WD1/GS/FW4/PB4/WN6/WN7/WS1
<i>Ajuga reptans</i>	Bugle	WD1/WS1/GS/PB4/WN6/WN7/PB1
<i>Allium ursinum</i>	Ramsons	GS/WS1/WN/FW1
<i>Alnus glutinosa</i>	Alder	GS/WS1/WN/WN7
<i>Andromeda polifolia</i>	Bog-rosemary	WN6/WN7/GS/PB4/WN2/WS1/WD1/PB1
<i>Angelica sylvestris</i>	Wild Angelica	WD1/WS1/GS/PB4/WN6/WN7
<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass	GS/WS1/WN6/WN7/FW1/PB4/PB1
<i>Anthriscus sylvestris</i>	Cow Parsley	PB1/WN6/WN7/WN2
<i>Apium nodiflorum</i>	Fool's-water-cress	WD1/GS/FW4/PB4/WN7/WS1/WN6/WN7
<i>Arrhenatherum elatius</i>	False Oat-grass	WD1/WS1/GS/PB4/WN6/WN7
<i>Asplenium scolopendrium</i>	Hart's-tongue fern	WD1/WS1/GS/PB4/WN6/WN7
<i>Athyrium filix-femina</i>	Lady-fern	GS/WS1/WN/FW1
<i>Bellis perennis</i>	Daisy	WD1/WS1/GS/PB4/WN6/WN7
<i>Bernula erecta</i>	Lesser Water-parsnip	WD1/WS1/GS/PB4/WN6/WN7
<i>Betula pendula</i>	Silver Birch	McG 2001
<i>Betula pubescens</i>	Downy Birch	WD1/GS/FW4/PB4/WN7/WN6/PB1/WN2
<i>Blechnum spicant</i>	Hard-fern	WD1/WS1/GS/PB4/WN6/WN7/FW4
<i>Brachypodium sylvaticum</i>	False-brome	WD1/GS/FW4/PB4/WN2/WN7
<i>Brassica napus</i>	Rape	WD1/GS/FW4/PB4/WN7
<i>Briza media</i>	Quaking-grass	WD1/WS1/GS/PB4/WN6/WN7
<i>Calluna vulgaris</i>	Heather	WN6/WN7/GS/PB4/WS1/WD1
<i>Caltha palustris</i>	Marsh-marigold	WD1/GS/FW4/PB1/PB4/WN7/WN2
<i>Calystegia sepium</i>	Hedge Bindweed	WD1/WS1/GS/PB4/WN6/WN7
<i>Capsella bursa-pastoris</i>	Shepherd's-purse	GS/WS1/WN/FW1
<i>Cardamine hirsuta</i>	Hairy Bitter-cress	WD1/GS/FW4/PB1/PB4/WD6/WN2/WN7
<i>Cardamine pratensis</i>	Cuckooflower	PB1/WN6/WN7/WN2/WD1/PB4
<i>Carex acutiformis</i>	Lesser Pond-sedge	WD1/WS1/GS/PB4/WN6/WN7/WN2/ FW4/PB1
<i>Carex curta</i>	White Sedge	
<i>Carex demissa</i>	Common Yellow Sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex diandra</i>	Lesser Tussock-sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex disticha</i>	Brown Sedge	

<i>Carex divisa</i>	Divided Sedge	
<i>Carex echinata</i>	Star Sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex elata</i>	Tufted-sedge	
<i>Carex flacca</i>	Glaucous Sedge	WD1/GS/FW4/PB4/WN7/WN6/PB1
<i>Carex panicea</i>	Carnation Sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex paniculata</i>	Greater Tussock-sedge	WN6/WN7/GS/PB4/WN2/WD1/FW4
<i>Carex pendula</i>	Pendulous Sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex pilulifera</i>	Pill Sedge	
<i>Carex remota</i>	Remote Sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex rostrata</i>	Bottle Sedge	WD1/WS1/GS/PB4/WN6/WN7
<i>Carex sylvatica</i>	Wood-sedge	WD1/GS/FW4/PB4/WN7/WS1
<i>Centaurea nigra</i>	Common Knapweed	WD1/WS1/GS/PB4/WN6/WN7
<i>Cerastium fontanum</i>	Common Mouse-ear	WD1/WS1/GS/PB4/WN6/WN7
<i>Chamerion angustifolium</i>	Rosebay Willowherb	WD1/WS1/GS/PB4/WN6/WN7
<i>Chrysosplenium oppositifolium</i>	Opposite-leaved Golden-saxifrage	WD1/GS/FW4/PB4/WN7
<i>Cirsium arvense</i>	Creeping Thistle	WD1/GS/FW4/PB4/WN7/WS1
<i>Cirsium palustre</i>	Marsh Thistle	WD1/WS1/GS/PB4/WN6/WN7
<i>Cirsium vulgare</i>	Spear Thistle	WD1/GS/FW4/PB4/WN7/PB1
<i>Corylus avellana</i>	Hazel	WD1/GS/FW4/PB4/WN7
<i>Cotoneaster</i> spp.	Cotoneaster	WN6/WN7/GS/PB4
<i>Crataegus monogyna</i>	Hawthorn	PB1/WN6/WN7/WN2/WS1/FW1/PB4
<i>Crococsmia potsii</i> × <i>aurea</i> = <i>C. × crocosmiflora</i>	Montbretia	WD1/WS1/GS/PB4/WN6/WN7
<i>Dactylis glomerata</i>	Cock's-foot	WD1/GS/FW4/PB4/WN7/WS1/WN6
<i>Dactylorhiza fuchsii</i>	Common Spotted-orchid	WD1/GS/FW4/PB4/WN7
<i>Daucus carota</i>	Wild Carrot	WD1/WS1/GS/PB4/WN6/WN7
<i>Deschampsia cespitosa</i>	Tufted Hair-grass	PB1/WN6/WN7/WN2/PB4/WD1
<i>Drosera rotundifolia</i>	Round-leaved Sundew	WD1/WS1/GS/PB4/WN6/WN7
<i>Drosera anglica</i>	Long leafed Sundew	2014
<i>Dryopteris affinis</i>	Scaly Male-fern	WN2/WN7
<i>Dryopteris carthusiana</i>	Narrow Buckler-fern	WD1/WS1/GS/PB4/WN6/WN7
<i>Dryopteris dilatata</i>	Broad Buckler-fern	PB1/WN6/WN7/WN2/PB4
<i>Dryopteris filix-mas</i>	Male-fern	WD1/GS/FW4/PB4/WN7
<i>Epilobium hirsutum</i>	Great Willowherb	WD1/WS1/GS/PB4/WN6/WN7
<i>Epilobium montanum</i>	Broad-leaved Willowherb	WD1/WS1/GS/PB4/WN6/WN7
<i>Epilobium palustre</i>	Marsh Willowherb	
<i>Equisetum arvense</i>	Field Horsetail	WD1/WS1/GS/PB4/WN6/WN7
<i>Equisetum fluviatile</i>	Water Horsetail	PB1/WN6/WN7/WN2
<i>Equisetum pratense</i>	Shady Horsetail	WD1/WS1/GS/PB4/WN6/WN7
<i>Equisetum telmateia</i>	Great Horsetail	
<i>Erica tetralix</i>	Cross-leaved Heath	WD1/WS1/GS/PB4/WN6/WN7
<i>Eriophorum angustifolium</i>	Common Cottongrass	WN6/WN7/GS/PB4/PB1
<i>Eriophorum vaginatum</i>	Hare's-tail Cottongrass	WN2/WN6/WN7/GS/PB4
<i>Euonymus europaeus</i>	Spindle	WD1/WS1/GS/PB4/WN6/WN7
<i>Eupatorium cannabinum</i>	Hemp-agrimony	WD1/WS1/GS/PB4/WN6/WN7/FW1

<i>Euphrasia officinalis</i> agg.	Eyebright	WD1/WS1/GS/PB4/WN6/WN7
<i>Fagus sylvatica</i>	Beech	WD1/GS/FW4/PB4/WN7/WN6/WD1
<i>Festuca rubra</i>	Red Fescue	WD1/WS1/GS/PB4/WN6/WN7
<i>Ficaria verna</i>	Lesser Celandine	WD1/GS/FW4/PB1/PB4/WN7
<i>Filipendula ulmaria</i>	Meadowsweet	WD1/GS/FW4/PB1/PB4/WN7/WN6/WN7
<i>Fragaria vesca</i>	Wild Strawberry	PB1/PB4/WN6/WN7/WN2/WS1/WD1
<i>Fraxinus excelsior</i>	Ash	WD1/GS/FW4/PB4/WN6/WN7
<i>Galium aparine</i>	Cleavers	WD1/WS1/GS/PB4/WN6/WN7
<i>Galium palustre</i>	Marsh-bedstraw	WD1/WS1/GS/PB4/WN6/WN7
<i>Geranium robertianum</i>	Herb-Robert	WD1/WS1/GS/PB4/WN6/WN7
<i>Geum rivale</i>	Water Avens	WD1/WS1/GS/PB1/PB4/WN6/WN7
<i>Geum urbanum</i>	Wood Avens	WD1/GS/FW4/PB1/PB4/WN7
<i>Glechoma hederacea</i>	Ground-ivy	WD1/WS1/GS/PB4/WN6/WN7
<i>Glyceria fluitans</i>	Floating Sweet-grass	WD1/GS/FW4/PB4/WN7/FW1/WS1
<i>Hedera helix</i>	Ivy	WD1/GS/FW4/PB4/WN7
<i>Heracleum sphondylium</i>	Hogweed	WD1/GS/FW4/PB4/WN7/WN6
<i>Holcus lanatus</i>	Yorkshire-fog	WD1/WS1/GS/PB4/WN6/WN7
<i>Holcus mollis</i>	Creeping Soft-grass	WD1/WS1/GS/PB4/WN6/WN7
<i>Hypericum maculatum</i> subsp. <i>obtusiusculum</i>	Imperforate St. Johns -wort	WD1/GS/FW4/PB4/WN7
<i>Hypericum pulchrum</i>	Slender St John's-wort	WD1/WS1/GS/PB4/WN6/WN7
<i>Hypericum tetrapterum</i>	Square-stalked St John's-wort	WD1/WS1/GS/PB4/WN6/WN7
<i>Hypochoeris radicata</i>	Cat's-ear	WD1/WS1/GS/PB4/WN6/WN7
<i>Ilex aquifolium</i>	Holly	WD1/FW4/PB1/PB4/WN7/FW1/WS1/WN6
<i>Iris pseudacorus</i>	Yellow Iris	WD1/GS/FW4/PB4/WN7/FW1/WN6/WN7
<i>Juncus acutiflorus</i>	Sharp-flowered Rush	WD1/WS1/GS/PB4/WN6/WN7
<i>Juncus bufonius</i>	Toad Rush	WD1/WS1/GS/PB4/WN6/WN7
<i>Juncus effusus</i>	Soft-rush	WD1/GS/FW4/PB4/WN7/WN6/WS1/PB4
<i>Juncus inflexus</i>	Hard Rush	WN6/WN7/GS/PB4
<i>Juncus tenuis</i>	Slender Rush	
<i>Larix decidua</i>	European Larch	PB1/WN6/WN7/WN2
<i>Lathyrus pratensis</i>	Meadow Vetchling	WD1/WS1/GS/PB1/PB4/WN6/WN7
<i>Lemna minor</i>	Common Duckweed	WD1/WS1/GS/PB4/WN6/WN7/FW4
<i>Leucanthemum vulgare</i>	Ox-eye Daisy	GS/WS1/WN/FW1/WD1/PB4/WN6/WN7
<i>Ligustrum vulgare</i>	Wild Privet	WD1/GS/FW4/PB4/WN7
<i>Lolium perenne</i>	Perennial Rye-grass	WN6/WN7/GS/PB4/PB1/WS1
<i>Lonicera periclymenum</i>	Honeysuckle	WD1/GS/FW4/PB4/WN7/WN6/WS1
<i>Lotus corniculatus</i>	Common Bird's-foot-trefoil	WD1/WS1/GS/PB4/WN6/WN7
<i>Luzula campestris</i>	Field Wood-rush	WD1/WS1/GS/PB4/WN6/WN7
<i>Luzula multiflora</i>	Heath Wood-rush	WD1/WS1/GS/PB4/WN6/WN7
<i>Luzula sylvatica</i>	Great Wood-rush	WD1/GS/FW4/PB4/WN6/WN7
<i>Lysimachia nemorum</i>	Yellow Pimpernel	WD1/GS/FW4/PB4/WN7
<i>Malus domestica</i>	Apple	WD1/WS1/GS/PB4/WN6/WN7
<i>Medicago lupulina</i>	Black Medick	WD1/WS1/GS/PB4/WN6/WN7
<i>Mentha aquatica</i>	Water Mint	WD1/GS/FW4/PB1/PB4/WN7/WS1

<i>Molinia caerulea</i>	Purple Moor-grass	WN6/WN7/GS/PB4/PB1/WD1/
<i>Myosotis arvensis</i>	Field Forget-me-not	WD1/GS/FW4/PB4/WN7/WS1
<i>Myrica gale</i>	Bog-myrtle	PB1/WN6/WN7/WN2
<i>Narthecium ossifragum</i>	Bog Asphodel	WD1/WS1/GS/PB4/WN6/WN7
<i>Origanum vulgare</i>	Wild Marjoram	WD1/WS1/GS/PB4/WN6/WN7
<i>Orobancha hederæ</i> ***	Ivy Broomrape	
<i>Petasites hybridus</i>	Butterbur	PB1/WN6/WN7/WN2/PB4/WD1
<i>Phalaris arundinacea</i>	Reed Canary-grass	WD1/WS1/GS/PB4/WN6/WN7
<i>Phragmites australis</i>	Common Reed	PB1/WN6/WN7/WN2/PB4/WD1
<i>Picea abies</i>	Norway Spruce	WD1/GS/FW4/PB4/WN7/PB1
<i>Picea sitchensis</i>	Sitka Spruce	WN6/WN7/GS/PB4
<i>Pinus sylvestris</i>	Scots Pine	PB1/WN6/WN7/WN2
<i>Plantago lanceolata</i>	Ribwort Plantain	WD1/WS1/GS/PB4/WN6/WN7
<i>Plantago major</i>	Greater Plantain	WD1/WS1/GS/PB4/WN6/WN7
<i>Poa annua</i>	Annual Meadow-grass	WD1/WS1/GS/PB4/WN6/WN7
<i>Poa pratensis</i>	Smooth Meadow-grass	WD1/WS1/GS/PB4/WN6/WN7
<i>Poa trivialis</i>	Rough Meadow-grass	GS/WS1/WN/FW1
<i>Polygala serpyllifolia</i>	Heath Milkwort	PB1/WN6/WN7/WN2
<i>Polygala vulgaris</i>	Common Milkwort	WD1/WS1/GS/PB4/WN6/WN7
<i>Polypodium vulgare</i>	Common Polypody	PB1/WN6/WN7/WN2
<i>Polystichum setiferum</i>	Soft Shield-fern	PB1/WN6/WN7/WN2
<i>Populus tremula</i>	Aspen	PB1/WN6/WN7/WD1/PB4/WN7
<i>Potamogeton polygonifolius</i>	Bog Pondweed	WD1/WS1/GS/PB4/WN6/WN7
<i>Potentilla erecta</i>	Tormentil	WD1/WS1/GS/PB4/WN6/WN7
<i>Potentilla reptans</i>	Creeping Cinquefoil	WD1/WS1/GS/PB4/WN6/WN7
<i>Potentilla sterilis</i>	Barren Strawberry	WD1/WS1/GS/PB4/WN6/WN7
<i>Primula vulgaris</i>	Primrose	WN2/WN7
<i>Prunella vulgaris</i>	Selfheal	GS/WS1/WN/FW1
<i>Prunus laurocerasus</i>	Cherry Laurel	WN6/WN7/GS/PB4
<i>Prunus padus</i> ***	Bird Cherry	WN2/WN7
<i>Prunus spinosa</i>	Blackthorn	WD1/WS1/GS/PB4/WN6/WN7
<i>Pteridium aquilinum</i>	Bracken	WD1/WS1/GS/PB4/WN6/WN7
<i>Quercus robur</i>	Pedunculate Oak	WD1/GS/FW4/PB4/WN7/WS1
<i>Ranunculus acris</i>	Meadow Buttercup	WD1/WS1/GS/PB4/WN6/WN7
<i>Ranunculus flammula</i>	Lesser Spearwort	WD1/GS/FW4/PB4/WN7
<i>Ranunculus repens</i>	Creeping Buttercup	WD1/GS/FW4/PB4/WN7
<i>Rhododendron ponticum</i>	Rhododendron	WD1/WS1/GS/PB4/WN6/WN7
<i>Rhynchospora alba</i>	White Beak-sedge	
<i>Rorippa nasturtium-aquaticum</i>	Water-cress	GS/WS1/WN/FW1
<i>Rosa arvensis</i>	Field-rose	WD1/WS1/GS/PB4/WN6/WN7
<i>Rosa canina</i> agg.	Dog Rose	WD1/WS1/GS/PB4/WN6/WN7
<i>Rubus fruticosus</i> agg.	Bramble	WD1/GS/FW4/PB4/WN7
<i>Rubus idaeus</i>	Raspberry	WD1/WS1/GS/PB4/WN6/WN7
<i>Rumex acetosa</i>	Common Sorrel	GS/WS1/WN
<i>Rumex crispus</i>	Curled Dock	WD1/GS/FW4/PB4/WN7/PB1/WN6/WN2

<i>Rumex obtusifolius</i>	Broad-leaved Dock	WD1/GS/FW4/PB4/WN7
<i>Rumex sanguineus</i>	Red-Veined Dock	WD1/WS1/GS/PB4/WN6/WN7
<i>Salix aurita</i>	Eared Willow	WD1/WS1/GS/PB4/WN6/WN7
<i>Salix caprea</i>	Goat Willow	WD1/WS1/GS/PB4/WN6/WN7
<i>Salix cinerea</i> subsp. <i>oleifolia</i>	Rusty Willow	WD1/GS/FW4/PB4/WN7/WN2/WN6/WS1
<i>Sambucus nigra</i>	Elder	WN2/WD1/GS/FW4/PB4/WN7
<i>Sanicula europaea</i>	Sanicle	WN2/WN7
<i>Sarracenia purpurea</i>	Pitcher Plant	1970's, 2002, 2009, 2013
<i>Scrophularia nodosa</i>	Common Figwort	WD1/WS1/GS/PB4/WN6/WN7
<i>Senecio jacobaea</i>	Common Ragwort	PB1/WN6/WN7/WN2/PB4/PB1
<i>Sinapis arvensis</i>	Charlock	GS/WS1/WN
<i>Smyrniium olusatrum</i>	Alexanders	GS/WS1/WN
<i>Solanum dulcamara</i>	Bittersweet	
<i>Sorbus aucuparia</i>	Rowan	WD1/WS1/GS/PB4/WN6/WN7
<i>Sparganium erectum</i>	Branched Bur-reed	WD1/WS1/GS/PB4/WN6/WN7
<i>Stachys palustris</i>	Marsh Woundwort	WD1/WS1/GS/PB4/WN6/WN7
<i>Stachys sylvatica</i>	Hedge Woundwort	WD1/WS1/GS/PB4/WN6/WN7
<i>Stellaria alsine</i>	Bog Stitchwort	WD1/GS/FW4/PB4/WN7
<i>Stellaria media</i>	Common Chickweed	WD1/GS/FW4/PB4/WN7
<i>Succisa pratensis</i>	Devil's-bit Scabious	WD1/WS1/GS/PB4/WN6/WN7
<i>Taraxacum officinale</i> agg.	Dandelion	WD1/GS/FW4/PB4/WN7/WN6/PB1/WN2
<i>Taxus baccata</i>	Yew	PB1/PB4/WN6/WN7/WN2
<i>Trichophorum cespitosum</i>	Deergrass	WD1/WS1/GS/PB1/PB4/WN6/WN7
<i>Trifolium dubium</i>	Lesser Trefoil	WD1/WS1/GS/PB4/WN6/WN7
<i>Trifolium pratense</i>	Red Clover	WD1/WS1/GS/PB4/WN6/WN7
<i>Trifolium repens</i>	White Clover	WD1/WS1/GS/PB4/WN6/WN7
<i>Tussilago farfara</i>	Coltsfoot	WD1/GS/FW4/PB4/WN7
<i>Typha latifolia</i>	Bulrush	PB1/WN6/WN7/WD1/PB4/WD1
<i>Ulex europaeus</i>	Gorse	WD1/GS/FW4/PB4/WN7/WS1
<i>Ulmus glabra</i>	Wych Elm	GS/WS1/WN2/WN7/FW1
<i>Urtica dioica</i>	Common Nettle	WD1/GS/FW4/PB4/WN7
<i>Vaccinium myrtillus</i>	Bilberry	PB1/PB4/WN6/WN7/WN2
<i>Vaccinium oxycoccos</i>	Cranberry	
<i>Valeriana officinalis</i>	Common Valerian	WD1/GS/FW4/PB4/WN7
<i>Verbascum thapsus</i>	Great Mullein	WD1/GS/FW4/PB4/WN7
<i>Veronica beccabunga</i>	Brooklime	GS/WS1/WN
<i>Veronica chamaedrys</i>	Germander Speedwell	WD1/GS/FW4/PB4/WN7/PB4
<i>Viburnum opulus</i>	Guelder-rose	WN2/WN7
<i>Vicia cracca</i>	Tufted Vetch	WN6/WN7/GS/PB4/PB1
<i>Vicia sepium</i>	Bush Vetch	WD1/GS/FW4/PB4/WN7/WN6/WS1
<i>Viola riviniana</i>	Common Dog-violet	WD1/GS/FW4/PB4/WN7/PB1/WS1/WN2

*** Species of local distinctiveness/national rarity- Red Data Book Species

N.B. Old records for *Thehypteris palustris* (Marsh Fern) and *Pyrola rotundifolia* (Round leaved Wintergreen), both Red Data book species, have not as yet been reconfirmed.

LICHENS

<i>Cladonia floerkeana</i>	Matchstick Lichen	2001
<i>Cladonia portentosa</i>	Reindeer Lichen	2001
<i>Cladonia uncialis</i>	Stags Horn Lichen	2001

LIVERWORTS

<i>Chiloscyphus</i> spp.	---	
<i>Lophocolea bidentata</i>	Bifid Crestwort	
<i>Odontoschisma sphagni</i>	Bog-moss Flapwort	
<i>Radula complanata</i>	Even Scalewort	
<i>Pellia</i> spp.	Common Pellia	
<i>Frullania tamarisci</i>	Tamarisk Scalewort	
<i>Frullania dilatata</i>	Dilated Scalewort	
<i>Metzgeria fruticulosa</i>	Bluish Veilwort	
<i>Metzgeria furcata</i>	Forked Veilwort	

MOSSES

<i>Barbula sardoa</i>	Lesser Bird's-claw Beard-moss	
<i>Brachythecium rutabulum</i>	Rough-stalked Feather-moss	
<i>Calliergon cordifolium</i>	Heart-leaved Spear-moss	
<i>Calliergonella cuspidata</i>	Pointed Spear-moss	
<i>Campylium stellatum</i>	Yellow Starry Feather-moss	
<i>Campylopus introflexus</i>	Heath Star Moss	
<i>Cratoneuron filicinum</i>	Fern-leaved Hook-moss	
<i>Cryphaea heteromalla</i>	Lateral Cryphaea	
<i>Ctenidium molluscum</i>	Chalk Comb-moss	
<i>Dicranum scoparium</i>	Broom Fork-moss	
<i>Eurhynchium striatum</i>	Common Striated Feather-moss	
<i>Fissidens taxifolius</i>	Common Pocket-moss	
<i>Homalothecium sericeum</i>	Silky Wall Feather-moss	
<i>Hylocomium brevirostre</i>	Short-beaked Wood-moss	
<i>Hypnum cupressiforme</i>	Cypress-leaved Plait-moss	
<i>Hypnum jutlandicum</i>	Heath Plait-moss	
<i>Hypnum resupinatum</i>	Supine Plait-moss	
<i>Isothecium myosuroides</i>	Slender Mouse-tail Moss	
<i>Kindbergia praelonga</i>	Common Feather Moss	
<i>Leucobryum glaucum</i>	Large White-moss	
<i>Mnium hornum</i>	Swan's-neck Thyme-moss	
<i>Neckera complanata</i>	Flat Neckera	
<i>Orthotrichum affine</i>	Wood Bristle-moss	
<i>Oxyrrhynchium bians</i>	Swartz's Feather-moss	
<i>Plagiomnium elatum</i>	Tall Thyme-moss	
<i>Pleurozium schreberi</i>	Red-stemmed Feather-moss	
<i>Polytrichum commune</i>	Common Haircap	

<i>Polytrichum formosum</i>	Bank Haircap	
<i>Pseudoscleropodium purum</i>	Neat Feather Moss	
<i>Racomitrium lanuginosum</i>	Woolly Fringe-moss	
<i>Rhytidiadelphus squarrosus</i>	Springy Turf-moss	
<i>Rhytidiadelphus triquetrus</i>	Big Shaggy-moss	
<i>Sphagnum capillifolium</i>	Red Bog-moss	
<i>Sphagnum cuspidatum</i>	Feathery Bog-moss	
<i>Sphagnum fimbriatum</i>	Fringed Bog-moss	
<i>Sphagnum fuscum</i>	Rusty Bog-moss	
<i>Sphagnum imbricatum sensu lato</i>	---	
<i>Sphagnum imbricatum</i> subsp. <i>austinii</i>	---	
<i>Sphagnum magellanicum</i>	Magellanic Bog-moss	
<i>Sphagnum palustre</i>	Blunt-leaved Bog-moss	
<i>Sphagnum papillosum</i>	Papillose Bog-moss	
<i>Sphagnum subnitens</i>	Lustrous Bog-moss	
<i>Sphagnum tenellum</i>	Soft Bog-moss	
<i>Thamnobryum alopecurum</i>	Fox-tail Feather-moss	
<i>Thuidium tamariscifolium</i>	Common Tamarisk-moss	
<i>Ulota bruchii</i>	Bruch's Pincushion	
<i>Ulota phyllantha</i>	Frizzled Pincushion	
<i>Zygodon</i> spp.	---	

MAMMALS - TERRESTRIAL

<i>Lutra lutra</i>	European Otter	
<i>Rattus norvegicus</i>	Brown Rat	
<i>Dama dama</i>	Fallow Deer	<i>Cervus elaphus</i> (Red Deer) rather than Fallow Deer has been claimed by some
<i>Martes martes</i>	Pine Marten	
<i>Meles meles</i>	Eurasian Badger	
<i>Lutra lutra</i>	European Otter	
<i>Lepus timidus</i> subsp. <i>hibernicus</i>	Irish Hare	
<i>Neovision vison</i>	American Mink	2013
<i>Sorex minutus</i>	Pygmy shrew	2002
<i>Vulpes vulpes</i>	Red Fox	

MAMMALS - AIR

<i>Pipistrellus pygmaeus</i>	Soprano Pipistrelle	
<i>Pipistrellus pipistrellus</i>	Common pipistrelle	

BIRDS

<i>Accipiter nisus</i>	Eurasian Sparrowhawk	GS/WN6/WN7/PB4/FW2
<i>Acrocephalus schoenobaenus</i>	Sedge Warbler	
<i>Aegithalos caudatus</i>	Long-tailed Tit	2014
<i>Anas platyrhynchos</i>	Mallard	WN7/PB1/ 2014
<i>Anthus pratensis</i>	Meadow Pipit	2014

<i>Apus apus</i>	Swift	2014
<i>Buteo buteo</i>	Common Buzzard	
<i>Carduelis cabaret</i>	Lesser Redpoll	2014
<i>Carduelis cannabina</i>	Linnet	2014
<i>Carduelis flammea</i>	Common Redpoll	2014
<i>Certhia familiaris</i>	Treecreeper	2014
<i>Columba palumbus</i>	Common Wood Pigeon	GS/WN6/WN7/PB4/FW2//2014
<i>Corvus cornix</i>	Hooded Crow	2014
<i>Corvus frugilegus</i>	Rook	2014
<i>Corvus monedula</i>	Eurasian Jackdaw	2014
<i>Cuculus canorus</i>	Common Cuckoo	PB1/WS1/ 2014
<i>Cyanistes caeruleus</i>	Blue Tit	GS/WN6/WN7/PB4/FW2/ 2014
<i>Delichon urbicum</i>	House Martin	2014
<i>Emberiza schoeniclus</i>	Reed Bunting	PB1/WS1
<i>Eritacus rubecula</i>	European Robin	GS/WN6/WN7/PB4/FW2/Pb1
<i>Falco tinnunculus</i>	Kestrel	2014
<i>Fringilla coelebs</i>	Chaffinch	GS/WN6/WN7/PB4/FW2/PB1/ 2014
<i>Gallinago gallinago</i>	Snipe	
<i>Hirundo rustica</i>	Barn Swallow	GS/WN6/WN7/PB4/FW2
<i>Locustella naevia</i>	Grasshopper Warbler	
<i>Motacilla cinerea</i>	Grey Wagtail	2014
<i>Parus major</i>	Great Tit	GS/WN6/WN7/PB4/FW2/ 2014
<i>Pariparus ater</i>	Coal Tit	2014
<i>Phasianus colchicus</i>	Common Pheasant	
<i>Phylloscopus collybita</i>	Common Chiffchaff	2014
<i>Phylloscopus trochilus</i>	Willow Warbler	GS/WN6/WN7/PB4/FW2/PB1/2014
<i>Pica pica</i>	Black-billed Magpie	
<i>Prunella modularis</i>	Dunnock	2014
<i>Pyrrhula pyrrhula</i>	Common Bullfinch	2014
<i>Regulus regulus</i>	Goldcrest	GS/WN6/WN7/PB4/FW2/ 2014
<i>Riparia riparia</i>	Sand Martin	
<i>Saxicola torquata</i>	Stonechat	2014
<i>Scolopax rusticola</i>	Eurasian Woodcock	PB1/WS1
<i>Streptopelia decaocto</i>	Eurasian Collared Dove	
<i>Sylvia atricapilla</i>	Blackcap	GS/WN6/WN7/PB4/FW2/ 2014
<i>Troglodytes troglodytes</i>	Wren	GS/WN6/WN7/PB4/FW2/2014
<i>Turdus merula</i>	Common Blackbird	GS/WN6/WN7/PB1/PB4/FW2/ 2014
<i>Turdus philomelos</i>	Song Thrush	2014
<i>Turdus viscivorus</i>	Mistle Thrush	WN7/PB1/ 2014

N.B. Much of the data is based upon observational records of many individuals. A systematic recording scheme has been initiated in April & May 2014 by Mr Ricky Whelan (IWT) based upon CBS protocol. Older records for birds such as *Saxicola rubetra* (Whinchat), *Alauda arvensis* (Skylark) and *Numenius arquata* (Curlew) have not recently been confirmed

BUTTERFLIES

<i>Aglais urticae</i>	Small Tortoiseshell	
<i>Anthocharis cardamines</i>	Orange-tip	GS/WN6/WN7/PB1/PB4/FW2
<i>Aphantopus hyperantus</i>	Ringlet	
<i>Argynnis paphia</i>	Silver Washed Fritillary	
<i>Callophrys rubi</i>	Green Hairstreak	
<i>Celastrina argiolus</i>	Holly Blue	
<i>Coenonympha tullia</i>	Large Heath	
<i>Erynnis tages</i>	Dingy Skipper	
<i>Euradryas aurinia</i>	Marsh Fritillary	Not reconfirmed since 2002.
<i>Gonepteryx rhamni</i>	Brimstone	
<i>Inachis io</i>	Peacock	
<i>Leptidea sinapis</i>	Wood White	WN6/WN7/GS/PB4/PB1/WS1
<i>Maniola jurtina</i>	Meadow Brown	
<i>Pararge aegeria</i>	Speckled Wood	WN6/WN7/GS/PB4/PB1/WS1
<i>Pieris brassicae</i>	Large White	GS/WS1
<i>Pieris napi</i>	Green-veined White	GS/WN6/WN7/PB4/FW2/WS1
<i>Pieris rapae</i>	Small White	
<i>Polyommatus icarus</i>	Common Blue	
<i>Vanessa atalanta</i>	Red Admiral	

MOTHS

<i>Abrostola triplasia</i>	Dark Spectacle	on old railway close to bog PB1
<i>Acronicta rumicis</i>	Knot Grass	on old railway close to bog PB1
<i>Alcis repandata</i>	Mottled Beauty	on old railway close to bog PB1
<i>Apamea crenata</i>	Clouded-bordered Brindle	on old railway close to bog PB1
<i>Biston betularia</i>	Peppered Moth	on old railway close to bog PB1
<i>Calliteara pudibunda</i>	Pale Tussock	on old railway close to bog PB1
<i>Chloroclysta truncata</i>	Common Marbled Carpet	on old railway close to bog PB1
<i>Colocasia coryli</i>	Nut-tree Tussock	on old railway close to bog PB1
<i>Cyclophora albipunctata</i>	Birch Mocha	on old railway close to bog PB1
<i>Deilephila elpenor</i>	Elephant Hawk-moth	on old railway close to bog PB1
<i>Drepana falcataria</i>	Pebble Hook-tip	on old railway close to bog PB1
<i>Ecliptopera silaceata</i>	Small Phoenix	on old railway close to bog PB1
<i>Ectropis bistortata</i>	Engrailed	on old railway close to bog PB1
<i>Electrophaes corylata</i>	Broken-barred Carpet	on old railway close to bog PB1
<i>Epirrhoe alternata</i>	Common Carpet	on old railway close to bog PB1
<i>Eupithecia exigua</i>	Mottled Pug	on old railway close to bog PB1
<i>Falcaria lacertinaria</i>	Scalloped Hook-tip	on old railway close to bog PB1
<i>Hepialus fusconebulosa</i>	Map-winged Swift	on old railway close to bog PB1
<i>Hydriomena impluviata</i>	May Highflyer	on old railway close to bog PB1
<i>Jodis lactearia</i>	Little Emerald	on old railway close to bog PB1
<i>Laotboe populi</i>	Poplar Hawk-moth	on old railway close to bog PB1
<i>Lomaspilis marginata</i>	Clouded Border	on old railway close to bog PB1
<i>Lycophotia porphyrea</i>	True Lover's Knot	on old railway close to bog PB1

<i>Melanbra (Ceramica) pisi</i>	Broom Moth	on old railway close to bog PB1
<i>Ochropacha duplaris</i>	Common Lutestring	on old railway close to bog PB1
<i>Odontopera bidentata</i>	Scalloped Hazel	on old railway close to bog PB1
<i>Opisthograptis luteolata</i>	Brimstone Moth	on old railway close to bog PB1
<i>Petrophora chlorosata</i>	Brown Silver-line	on old railway close to bog PB1
<i>Pheosia gnoma</i>	Lesser Swallow Prominent	on old railway close to bog PB1
<i>Plagodis dolabraria</i>	Scorched Wing	on old railway close to bog PB1
<i>Protodeltote pygarga</i>	Marbled White Spot	on old railway close to bog PB1
<i>Pterostoma palpina</i>	Pale Prominent	on old railway close to bog PB1
<i>Selenia dentaria</i>	Early Thorn	on old railway close to bog PB1
<i>Thera obeliscata</i>	Grey Pine Carpet	on old railway close to bog PB1
<i>Thyatira batis</i>	Peach Blossom	on old railway close to bog PB1
<i>Xanthorhoe montanata</i>	Silver-ground Carpet	on old railway close to bog PB1

N.B. This data is based upon a single nights capture & identification by Ms Ciara Flynn for the 2013 bioblitz

AMPHIBIANS & REPTILES

<i>Lissotriton vulgaris</i>	Smooth Newt	
<i>Rana temporaria</i>	Common Frog	GS/WN6/WN7/PB4/FW2/PB1
<i>Zootoca vivipara</i>	Common Lizard	

BEETLES

<i>Coccinella 7-punctata</i>	7-spot Ladybird	GS/WS1/FW4/PB1
<i>Dytiscus marginalis</i>	Great Diving Beetle	
<i>Melolontha melolontha</i>	Common Cockchafer/Maybug	
<i>Orectochilus villosus</i>	Hairy Whirligig Beetle	

WATER SCORPIONS

? <i>Nepa cinerea</i> ?	Water Scorpion	
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DRAGONFLIES & DAMSELFLIES

<i>Aeshna juncea</i>	Common Hawker	GS/WS1/FW4
<i>Calopteryx virgo</i>	Beautiful Demoiselle	GS/WS1
<i>Enallagma cyathigerum</i>	Common Blue Damselfly	
<i>Lestes sponsa</i>	Emerald Damselfly	GS/WS1
<i>Libellula quadrimaculata</i>	Four-spotted Chaser	GS/WS1/FW4/PB1
<i>Pyrrhosoma nymphula</i>	Large Red Damselfly	GS/WS1
<i>Calopteryx splendens</i>	Banded Demoiselle damselfly	2014

BEES & WASPS

<i>Bombus jonellus</i>	Heath bumblebee	PB1/WS1
<i>Bombus lucorum</i> agg.	White tailed Bumblebee	GS/WN6/WN7/PB1/PB4/FW2/WS1
<i>Bombus pascuorum</i>	Brown-banded carderbee	PB1/WS1
<i>Bombus terrestris</i>	Buff tailed Bumblebee	

SPIDERS

<i>Agalenatea redii</i>	---	2013
<i>Anyphaena accentuata</i>	---	2013
<i>Araneus diadematus</i>	Cross Spider	2013
<i>Clubiona</i> (immature)	---	2013
<i>Dictyna arundinacea</i>	Common mesh-weaver	2013
<i>Dolomedes fimbriatus</i>	Raft Spider	2013
<i>Enoplognatha ovata</i>	Candy Stripe Spider	2013
<i>Microlinyphia pusilla</i>	Small Hanky Weaver	2013
<i>Pirata piraticus</i>	Pirate Wolf Spider	2013
<i>Pisaura mirabilis</i>	Nursery Web Spider	2013
<i>Simitidion simile</i>	---	2013
<i>Tetragnatha extensa</i>	Common Stretch-Spider	2013
<i>Theridion impressum</i>	---	2013
<i>Theridion sisyphium</i>	Mother Care Spider	2013
<i>Tibellus</i> (immature)	---	2013
<i>Trochosa terricola</i>	Wolf Spider	2013

N.B. This data, kindly supplied by Myles Nolan is based on a limited sampling in a single area on the eastern edge of the bog

GRASSHOPPERS, GROUNDHOPPERS & CRICKETS

<i>Omocestus viridulus</i>	Common Green Grasshopper	2002, Bioblitz
<i>Chorthippus brunnea</i>	Common Field Grasshopper	2002
<i>Tetrix subulata</i>	Slender Groundhopper	2002
<i>Tetrix undulata</i>	Bog Groundhopper	2002
<i>Stethophyma grossum</i>	Large Marsh Grasshopper	2012

MOLLUSCS

<i>Acroloxus lacustris</i>	---	2000
<i>Aegopinella pura</i>	---	2000
<i>Arion ater</i>	Black slug	2000
<i>Arion circumscriptus</i>	Brown-banded Arion	2000
<i>Bathymphalus contortus</i>	Twisted Ram's Horn	2000
<i>Cepea nemoralis</i>	Brown-lipped snail	2000
<i>Clausilia bidentata</i>	Two Toothed Door Snail	2000
<i>Cochlicopa lubricella</i>	---	2000
<i>Columella edentula</i>	Toothless Chrysalis Snail	2000
<i>Columella aspera</i>	---	2000
<i>Deroceras reticulatum</i>	Grey garden slug	2000
<i>Discus rotundatus</i>	Rotund Disc	2000
<i>Leiosstyla anglica</i>	---	2000
<i>Lymnaea palustris</i>	---	2000

<i>Radix (Lymnaea) peregra</i>	---	2000
<i>Lymnaea trunculata</i>	Dwarf marsh snail	2000
<i>Helix aspersa</i>	Garden Snail	2000
<i>Oxyloma pfeifferi</i>	---	2000
<i>Physa fontinalis</i>	Common bladder snail	2000
<i>Pisidium spp.</i>	Pea Clam	2013
<i>Pisidium personatum</i>	Red crusted pea mussel	2000
<i>Pisidium subtruncatum</i>	Pill Clam	2000
<i>Potamopyrgus antipodarum</i>	New Zealand Mudsnailed	2000
<i>Sphaerium corneum</i>	European fingernail Clam	2000
<i>Trochulus striolatus</i>	Strawberry Snail	2000
<i>Valvata piscinalis</i>	Valve snail	2000
<i>Vertigo moulinsiana</i>	Desmoujlin's Whorl Snail	2000

FISH

<i>Gasterosteus aculeatus</i>	Three-spined Stickleback	2013
<i>Lampetra planeri</i>	Brook Lamprey	2013
<i>Salmo trutta</i>	Trout	2013

Appendix 3: Indicative Models whose data when taken in conjunction suggests high potential restoration possibilities on Abbeyleix Bog (Source: RPS Consultants)

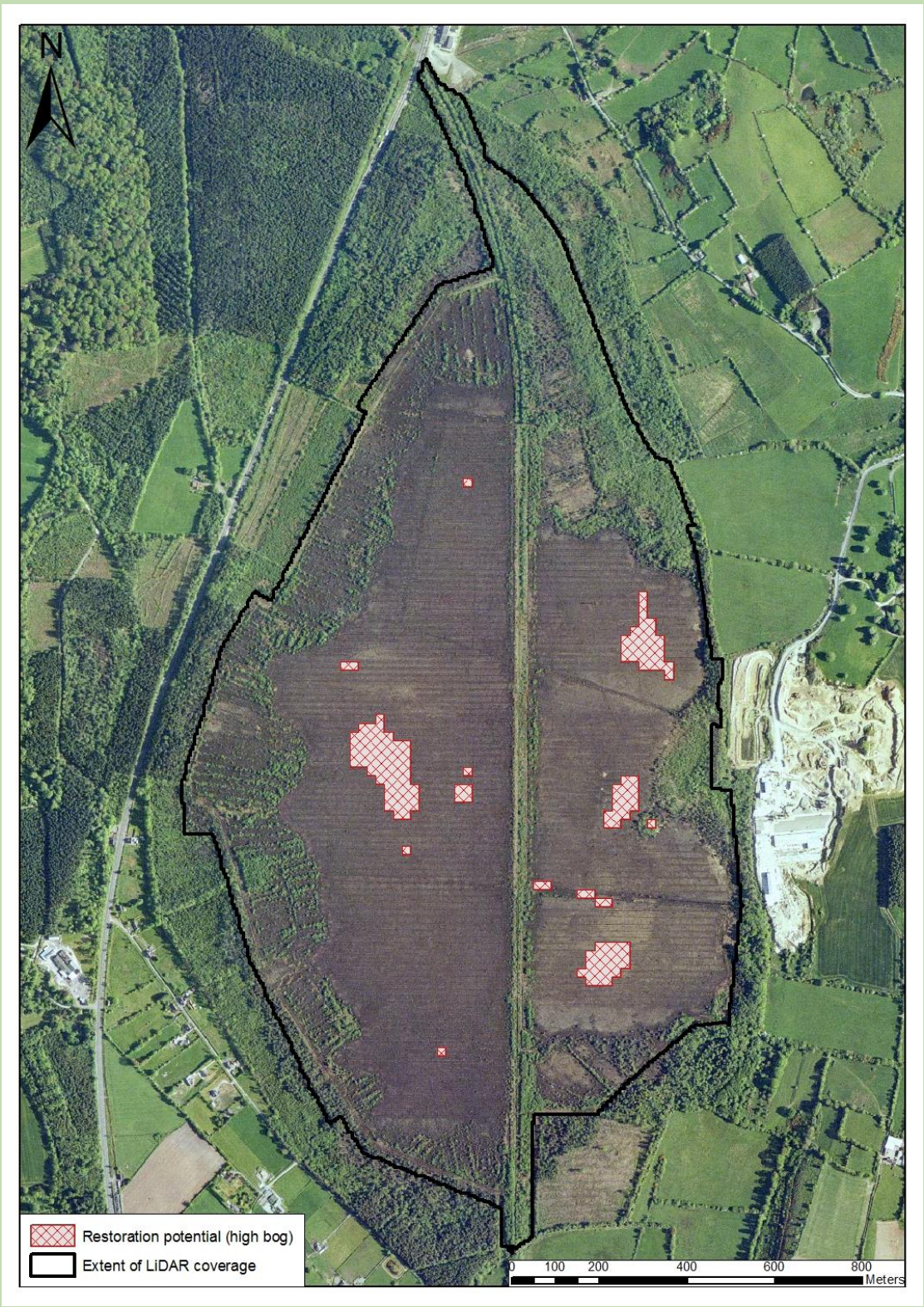
Map 1 - Modelled Potential for Restoration of High Bog

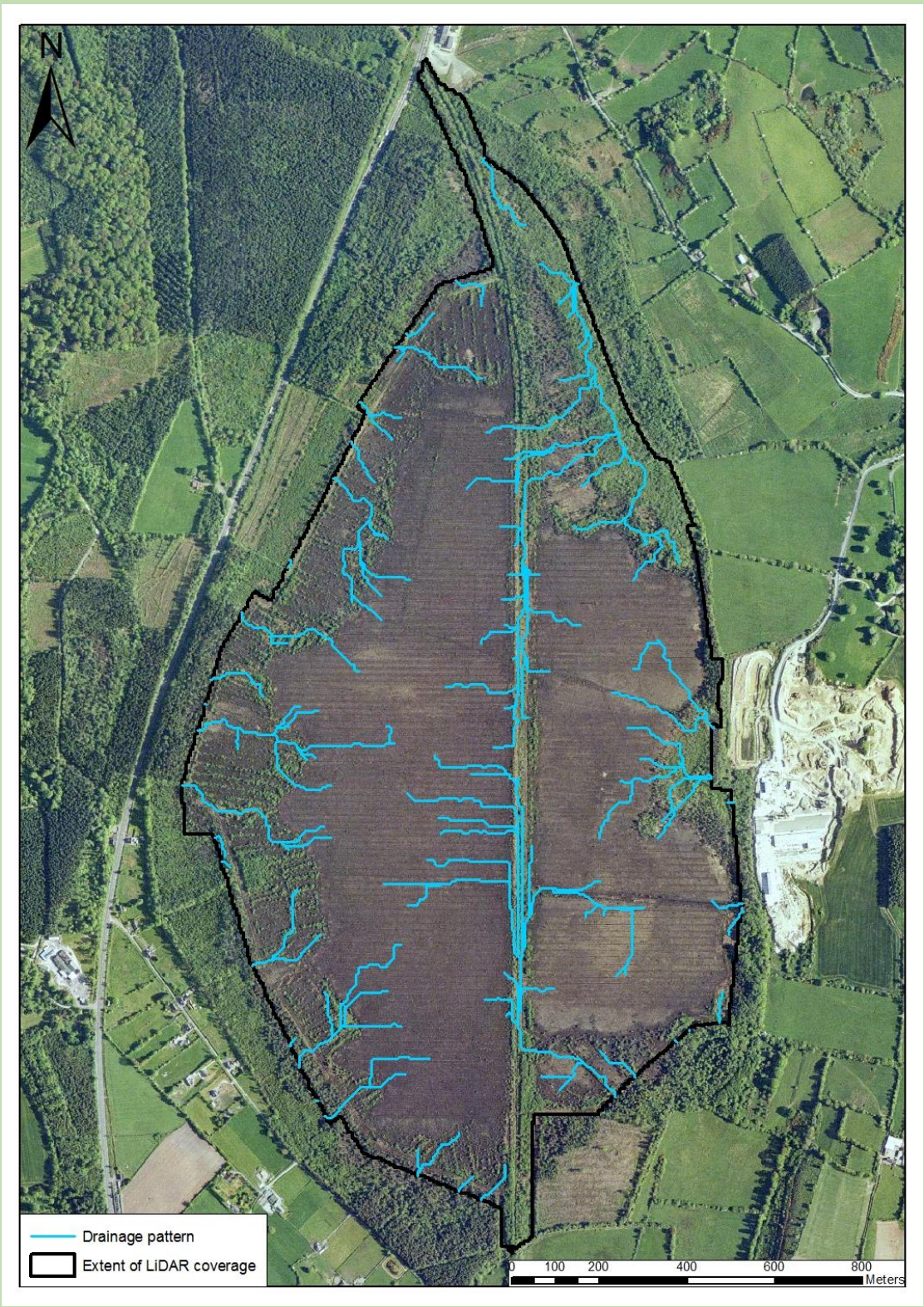
Map 2 - Drainage Map

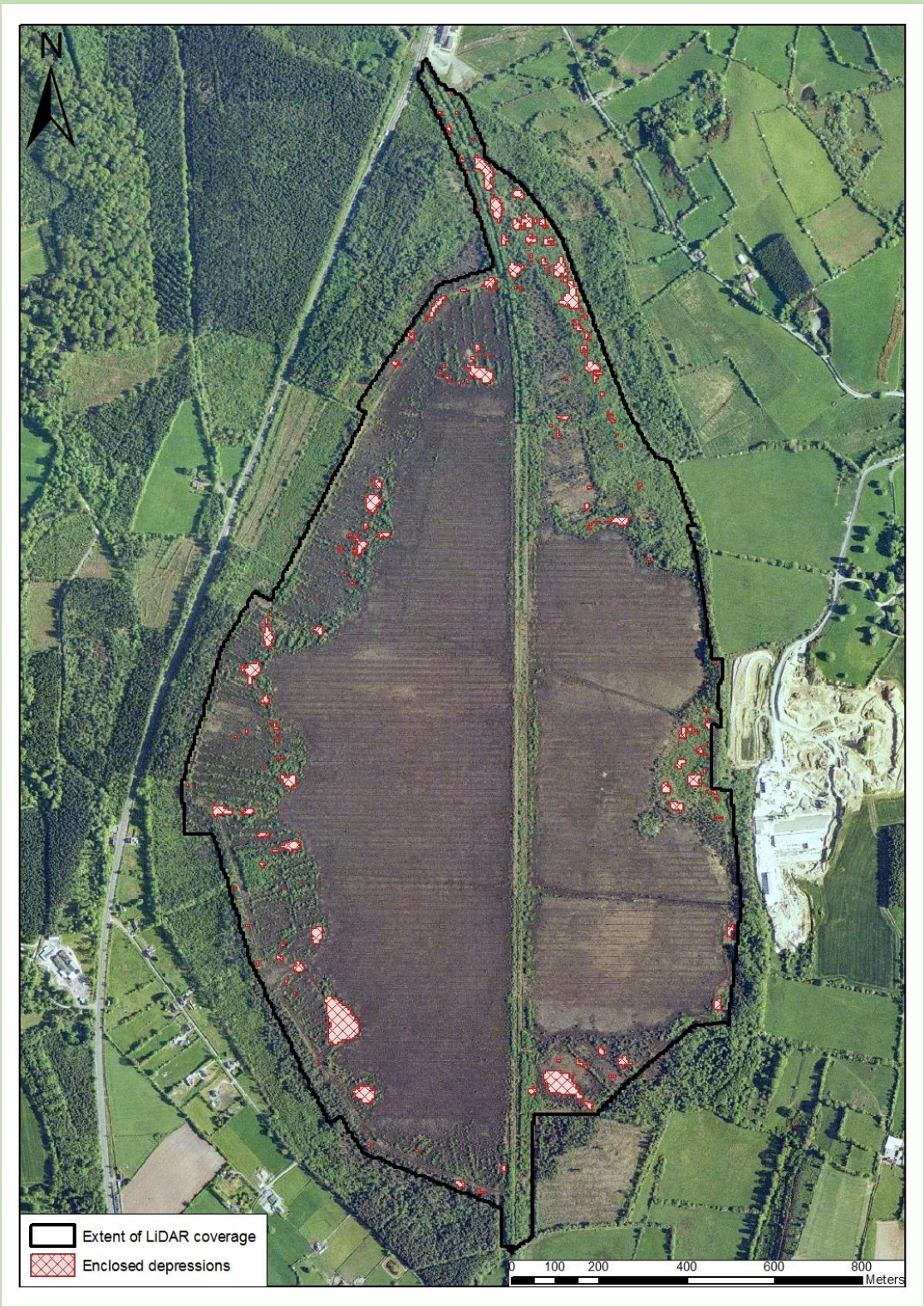
Map 3- Enclosed Depressions with potential for re-establishing peat forming habitats

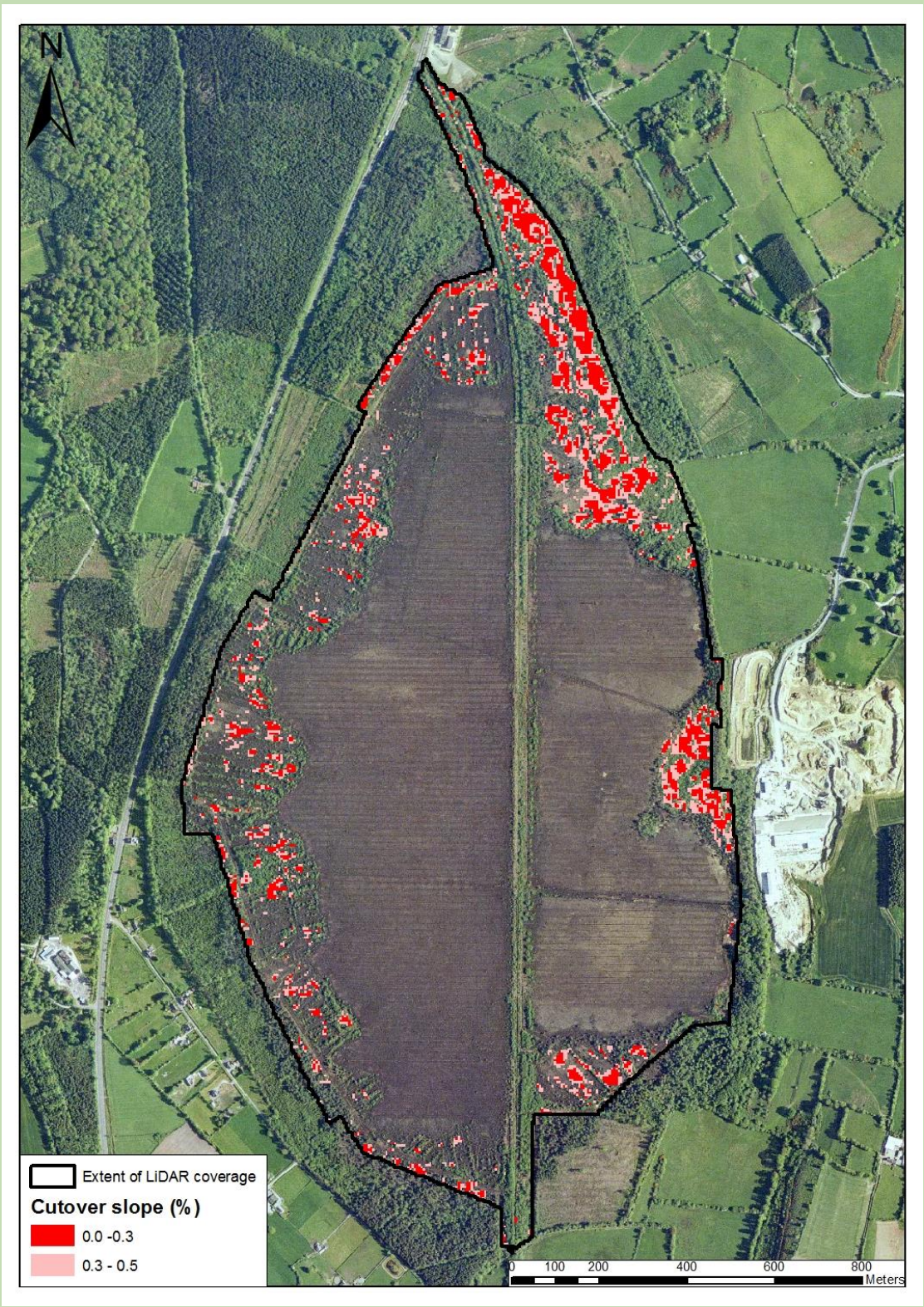
Map 4 – Cutover Slopes and areas of potential bog restoration

Continued overleaf









Appendix 4: Methodology for Predictive Arachnid Sampling (Courtesy of M Noolan.)

The predictive approach that involves utilising database information showing associations between spider species and their favoured habitats and micro-habitats (M. Nolan pers. comm.). The developing Irish database is largely based on the results of Nolan (2007a & b, 2008, 2009, 2013).

The principle advantage of the predictive approach lies in the fact that it allows one to note the species that are absent from a habitat but *should* be there. The usefulness of this approach is that an inventory allows one to establish a baseline against which future assessments of the fauna in the same location can be set, a list of expected species allows one to see if improvements to the habitat do have the effect of allowing extinguished species to return. Thus, if absent species are representative of very particular conditions in a habitat, an understanding of their requirements might assist both in planning habitat rehabilitation and assessing the results of same.

In terms of Abbeyleix Bog, the compilation of a spider inventory would involve an assessment of all the various sub-habitats at the site. Thereafter, one could generate a series of lists of spider species associated with each sub-habitat and to design a sampling protocol appropriate to same. Based on the species found it would be possible to provide recommendations regarding the conservation of the bog. Spiders are such a diverse group that very distinctive subsets of species would be found in association with the different habitats available.