

National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007



by Dr Peter Foss

Plant Ecologist, Botanist & Wetland
Conservationist

January 2007



National Parks
& Wildlife Service

National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007

Internal report for the National Parks and Wildlife Service,
Department of the Environment, Heritage and Local Government, Ireland.

Prepared by:

Dr Peter Foss
Plant Ecologist, Botanist and Wetland Conservationist

33 Bancroft Park
Tallaght
Dublin 24
e-mail: peter.foss@freenet.de

January 2007

National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007 by Peter Foss

Foss, P.J. 2007 Title: National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007. Internal report for the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

Copyright National Parks and Wildlife Service 2007

Author: Dr Peter Foss
33 Bancroft Park
Tallaght
Dublin 24

e-mail: peter.foss@freenet.de

All rights reserved. No Part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical photocopying, recording or otherwise without the prior permission of the National Parks and Wildlife Service.

Views reflected in this report do not necessarily reflect the views of the Minister for the Environment, Heritage and Local Government.

Report cover images :
Top: Pollardstown Fen, Co Kildare
Bottom left: Fennor Bog, Co. Waterford
Bottom right: Rathavisteen Flush, Co. Mayo
(All photographs copyright property of Peter Foss 2007)

Contents

| | Page No. |
|--|----------|
| Acknowledgements | 1 |
| 1. Executive Summary | 2 |
| 2. Introduction to the present study | 5 |
| 3. Introduction to Irish Fens | 7 |
| 4. Classification systems for Irish Fens | 9 |
| 4.1 Fen topography and hydrological classification scheme | 9 |
| 4.2 EU Habitats Directive Annex 1 classification scheme | 11 |
| 4.3 CORINE fen classification scheme | 14 |
| 4.4 Heritage Council classification scheme for fens and related wetlands | 17 |
| 4.5 Previous NPWS fens & flushes classification scheme | 24 |
| 4.6 Fen floristic and phytosociological classification | 25 |
| 4.7 Fen classification scheme based on underlying peat soils | 30 |
| 5. Former Extent of Fens in Ireland | |
| 5.1 Peatlands of Ireland fen extent | 31 |
| 5.2 An Foras Forbartha habitat survey | 33 |
| 5.3 Irish Peatland Conservation Council fen extent | 35 |
| 5.4 The NPWS fen conservation process and fen extent | 38 |
| 6. Compilation of the NPWS Fen Study Database | |
| 6.1 Background | 41 |
| 6.2 Materials & Methods | 41 |
| 6.2.1 Background site research | 41 |
| 6.2.2 Identification of sites with fen habitats | 41 |
| 6.2.3 Site Complexes - Main site & sub-unit(s) records | 42 |
| 6.2.4 Fen habitat type classification | 42 |
| 6.2.5 Classification system used in the NPWS Fen study | 42 |
| 6.2.6 Fen habitats area estimation on sites | 45 |
| 6.2.7 National information survey for undesignated fen sites | 45 |
| 6.2.8 Compilation of NPWS Fen Study Database | 46 |
| 6.2.9 Fen site evaluation | 46 |
| 6.3 The location of potential new fen sites in Ireland | |
| 6.3.1 County Wetland Analysis | 50 |
| 6.3.2 Digital fen soils and wetland distribution analysis | 51 |
| 7. Results | |
| 7.1 Present extent of fens in Ireland | 52 |
| 7.1.1 Limitations of the data | 52 |
| 7.1.2 Summary findings on the extent of fens in Ireland | 54 |
| 7.1.3 Fens in Ireland designated for SAC Annex 1 Fen Habitats | 60 |
| 7.1.4 Fen habitats on cSAC and SAC sites in Ireland | 62 |
| 7.1.5 Fen habitats on cNHA and NHA sites in Ireland | 64 |
| 7.1.6 Recently reported undesignated Fen sites in Ireland | 66 |
| 7.1.7 Evaluation of Fens within NPWS Fen Study Database | 68 |
| 7.2 The location of potential new fen sites of conservation value in Ireland | |
| 7.2.1 County Wetland Analysis | 72 |
| 7.2.2 Digital fen soils and wetland distribution analysis | 78 |
| 8. Conclusion | 86 |
| 9. Recommendations for a future Irish Fen field survey | 88 |
| 10. Bibliography | 89 |

| | |
|--|-----|
| 11. Appendices | |
| 1. Reports & Information sources consulted during the compilation of the NPWS Fen Study Database | 98 |
| 2. Groups & Individuals consulted in the compilation of data for the NPWS Fen Study Database | 102 |
| 3. Groups & Individuals who responded and submitted information to the NPWS Fen Study | 104 |
| 4. NPWS Fen Study data sources and import methodology | 106 |
| 5. NPWS Fen Study database structure | 111 |
| 6. NPWS Fen Study database layouts | 120 |
| 7. NPWS Fen Study habitat classification scheme used for fens | 131 |
| 8. Glossary of terms used | 134 |
| 9. NPWS Fen Study Site lists | 142 |
| 12. NPWS Fen Study CD ROM | 174 |

Acknowledgements

My thanks are due to Dr. Colmán Ó Críodáin, National Parks and Wildlife Service for invaluable discussions and comments throughout the period of compilation of the fen study database and preparation of this study report.

Thanks also to Dr. Michael Wyse-Jackson, Dr. Niel Lockhart and Edwin Wymer for their assistance with providing data on sites and information held in the NPWS Fen Study database and for their patience in helping to sort out numerous queries and problems.

Special thanks to Fernando Valverde and Gemma Weir for their help with the mapping of sites listed in the NPWS fens database.

The author especially wishes to thank the following individuals and groups for their feedback and assistance during the collection of data used in the preparation of this report: Con Breen, Shirley Clerkin, Tom Curtis, Rodney Daunt, John Derwin, Caitriona Douglas, Katherine Duff, Robert Edge, Catherine Farrell, Bernie Guest, Caroline Hurley, Naomi Kingston, Deirdre Lynn, Shirley Markley, Catherine O'Connell and Deborah Tiernan.

And finally, thanks to Deaglán Ó Caoimh for editorial comments during the preparation of the final study report and proof reading and finding all those hyphenated terms.

1. Executive Summary

1. The aim of this NPWS Fen Study was to consolidate information on the Extent and Conservation Status of Irish Springs, Fens and Flushes (hereafter referred to collectively as fens) based on existing information held by the National Parks & Wildlife Service and by other interested parties nationally.
2. No systematic national survey of fens has yet been undertaken in Ireland, in contrast to the situation for raised and blanket bogs. This study aimed to ascertain our current understanding of the fen resource in Ireland, and what is currently known about this resource in terms of the number of sites present, the various fen vegetation types that occur within these sites and the extent of each fen type.
3. This study addressed the following research objectives:
 - ◊ collect and amalgamate data on known fen sites of conservation importance in Ireland from within the NPWS and following consultation with external groups;
 - ◊ produce a computerised inventory of all sites of known or possible conservation value to include key data on each site, including the specific fen vegetation type(s) present; the known or estimated area of each fen vegetation type; and compile available published and survey information on sites;
 - ◊ collect data on fen sites without a current conservation designation (outside the NHA and SAC network) but which might be considered for NHA or SAC designation by NPWS following survey and evaluation;
 - ◊ examine where other sites of conservation interest might be located based on local soil, geological and environmental factors;
 - ◊ assess the past and present extent of 6 fen and fen-related habitats in Ireland;
 - ◊ evaluate each site in terms of its conservation importance, known area information, known survey information, and assign a survey priority to each;
 - ◊ make recommendations for a future national fen field survey.
4. The present study focused on 6 fen habitat types of conservation importance (four of which are listed in Annex 1 of the EU Habitats Directive, two of which - denoted with an asterisk - are priority habitats) in Ireland:
 - 7140 Transition mires and quaking bogs (Fossitt category PF3)
 - 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davalliana* (Fossitt category PF1)
 - 7220 * Petrifying springs with tufa formation (*Cratoneurion*) (Fossitt category FP1)
 - 7230 Alkaline fens (Fossitt category PF1)
 - Poor Fens - *Caricion curto-nigrae* (Fossitt category PF2)
 - Non-Calcareous springs - *Cardamino - Montion* (Fossitt category FP2)
5. These fen habitat types can be found as discrete fen communities in their own right, or in association with (or within) blanket bog, raised bog, turlough, dune slack, machair, wet heathland, wet grassland, woodland, karst areas, lacustrine and riverine habitats and systems.
6. A variety of data sources (reports, publications, databases and inventory lists), groups and individuals were consulted in the compilation of information for the NPWS Fen Study database, over an eight month period in 2006, both within NPWS and from external sources. Those contacted, and the respondents, are listed in the Appendices 2 & 3, while published research sources consulted are listed in

Appendix 1 and the Bibliography.

7. The past extent of fens in Ireland (based on Anonymous 1981; Hammond 1979; Foss, P.J., O'Connell C.A. & Crushell P. (eds.), 2001 inter alia) is presented. The original area of fens in Ireland is estimated to have been at least 92,508 ha (Hammond 1979). An estimated 19,660 ha of conservation worthy intact fens, occurring in 367 discrete sites were recognised in Ireland by IPCC in 2001 (Foss et al. 2001).
8. The total area of estimated fen vegetation (as defined in one of the 6 fen categories being examined in the present study) recorded in the NPWS Fen Study amounted to 22,180 ha within 681 discrete sites (site complex sub-units omitted i.e. sub-sites that occur within existing SAC or NHA). In total the NPWS Fen Study database holds information on 808 sites (which includes 127 sub-site records), where fen habitats are known or believed to occur.
9. In relation to the fen habitat types classified within the present NPWS Fen Study, the following number of sites and estimated area (ha) of fen vegetation have been recorded:
 - 7210 *Calcareous fens with *Cladium mariscus*: 122 sites with a fen area of 1,486 ha
 - 7230 Alkaline fens: 380 sites with a fen area of 6,830 ha
 - Poor Fens: 379 sites with a fen area of 11,841 ha
 - 7140 Transition mires and quaking bogs: 173 sites with a fen area of 1,955 ha
 - 7220 * Petrifying springs: 112 sites with a fen area of 36 ha
 - Non-Calcareous springs: 33 sites with a fen area of 32 ha
10. Annex 1 fens (i.e. Alkaline fen, Cladium fen, Transition mire, and Petrifying spring) which more closely relates to the fen types identified in previous studies, was estimated to cover 10,307 ha or 46% of the total fen area estimated in the present study. This is an indication that Annex 1 fens are less widespread than previously estimated (IPCC 2001).
11. The most abundant fen type found in the course of this study was Poor fen with an estimated national cover of 11,841 ha or 53% of the total area estimated in the present fen study.
12. These fens can be categorised, in terms of their current conservation designation, as follows:
 - The number and area (ha) of fens which have been designated for Annex 1 fen habitats under the Habitats Directive: 68 discrete sites with an area of 2,190 ha of designated fen habitat; representing 10% of the total estimated fen resource in Ireland; or 21% of the total Annex 1 fen resource estimated for Ireland
 - The number and area (ha) of fen sites which are within designated Natural Heritage Areas (NHA) or proposed candidate Natural Heritage Areas (cNHA): 363 sites with an area of 4,384 ha; representing 20% of the total estimated Irish fen resource
 - The number and area (ha) of fen sites which are located within designated Special Areas of Conservation (SAC) or proposed candidate Special Areas of Conservation (cSAC): 362 sites with an area of 14,086 ha; representing 64% of the total estimated Irish fen resource

The number of fen sites which have been “newly” discovered or reported to the NPWS Fen Study and have no current conservation designation at present: 88 sites with an area of 3,794 ha; representing 17% of the total estimated Irish fen resource

13. It is very probable that sites with conservation worthy fen communities exist outside of the sites which have been identified in the present NPWS Fen Study.
14. To identify zones and counties where potential new fens might occur, two analyses were undertaken as part of the NPWS Fen Study; a county wetland analysis and a digital fen soils analysis.
15. The county wetland analysis was designed to identify those counties most likely to contain additional fen sites (from alkaline to more acid fen types). This analysis was based on the past and present fen and bog resource status within the county, soil type, geology and geomorphological land form suitability, past survey work on wetlands, the number and extent of lakes present, and the number of new fens notified to the present NPWS Fen Study. This revealed the following counties which had the highest probability that additional fens might be discovered: Galway, Leitrim, Limerick, Monaghan, Mayo, Offaly, Sligo and Westmeath.
16. The digital fen soils analysis compared the original and known distribution of peat soils in each county with an overlay of the existing network of conserved areas (NHA and SAC) and the fen sites identified in this study. A series of regions were identified, where fen soils occur but fen sites are lacking. Assuming favourable environmental conditions are present, these zones might be likely to reveal additional fen sites of conservation value, following a detailed fen field survey, and merit further investigation. The counties with the most significant potential fen zones included: Clare, Galway, Kildare, Leitrim, Laois, Mayo, Offaly, Tipperary and Westmeath.
17. Based on the results of these two analyses, this study recommends that the following counties should be prioritised as part of any future NPWS Fen Field Survey: Clare, Galway, Kildare, Leitrim, Limerick, Mayo, Offaly, Roscommon and Westmeath.
18. In relation to the 808 fen sites identified in the NPWS Study, one key result to emerge is that significant gaps exist in relation to our knowledge of this resource. Specifically, the following issues have been identified:

Fen type identification: our knowledge in relation to the specific fen type(s) present, is considered wholly lacking or inadequate (confusion over one or more fen types) for 268 (33%) of sites identified in the present NPWS Fen Study database.

Extent of fen types: our knowledge in relation to the extent of fen type(s) present on sites, is considered wholly lacking for 102 sites (13%), and inadequate for a some further 600 sites (i.e. 74%, where only estimated data on fen extent is presently available) identified in the NPWS Fen Study database.
19. Our incomplete knowledge of many Irish fens makes a systematic survey of existing and newly reported sites a priority, if conservation worthy sites are to be identified and the best examples put forward for conservation under the Natural Heritage Area or European Habitats Directive Natura 2000 (SAC) network.

2. Introduction to the present study

To date no field survey focusing exclusively on intact fens to identify those of conservation value has been undertaken in Ireland. Any information on fens of conservation value that has been recorded in other surveys has often been coincidental.

This lack of a national field based fen survey and the difficulties caused has been highlighted in the most recent Irish Peatland Conservation Council (IPCC) Bogs & Fens of Ireland Conservation Plan (Foss, O'Connell & Crushell 2001), Crushell (2000, 2002), Doyle & O Críodáin (2003), and Dwyer (2000) inter alia.

This lack of survey is in contrast to extensive National Parks and Wildlife Service (NPWS) surveys which have been conducted on the two other main peatland types in Ireland, namely raised bogs and blanket bogs (Cross 1990; Douglas et al. 1984, 1985, 1986, 1987, 1989, 1989b, 1989c, 1990; Foss & McGee 1987; Mooney 1991; O'Connell & Mooney 1983; inter alia).

This lack of a national fen survey has presented difficulties in the past in ensuring that a representative sample of the most important fen sites are given adequate conservation designation and protection within the Natural Heritage Area (NHA) and Natura 2000 Special Areas of Conservation (SAC) networks (Dwyer 2000; Crushell 2002; Foss et al. 2001).

Furthermore, variability and reliability of known fen data, in terms of recency and quality of data varies considerably among sites, making it difficult to compare sites across the country when trying to compile an inventory of the most important fens of a particular type and those that should be prioritised for conservation.

As Ireland has an obligation to report and provide updates on its conservation actions on sites within the Natura 2000 network, this NPWS Fen Study was designed to provide information to the Natura 2000 reporting process for the four Annex 1 fen habitats occurring in Ireland.

The present study is the first stage in the implementation of a national fen survey which is to be undertaken by the National Parks and Wildlife Service.

Aims & Objectives of the present study

The main aims of the NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland was to:

- ◊ collect and amalgamate data on known fen sites of conservation importance in Ireland from data sources both within the NPWS, and following consultation, from external research groups and individuals;
- ◊ produce a computerised inventory of all fen sites of known or potential conservation value to include key data on each site, including the specific fen vegetation type present (where known); current area of each fen vegetation type (where known); available published and general survey information on the site;
- ◊ collect data on fen sites without a current conservation designation (i.e. outside the NHA and SAC network) but which might be considered for future NHA designation by NPWS following a field survey;
- ◊ examine where other fen sites of conservation interest might be located based on local soil, geological and environmental factors;
- ◊ assess the past extent of fens and the present extent of the 6 fen habitats recognised within the current NPWS Fen Study, in Ireland;

- ◊ evaluate each site in terms of its conservation importance, area information, survey information, and priority in terms of the need for a field survey;
- ◊ make recommendations towards a future NPWS National Fen Field Survey

3. Introduction to Irish Fens

What is a fen?

fen - a wetland system with a permanently high water level at or just below its surface, that receives nutrients via direct contact with mineral enriched surface or groundwater. The substrate is an alkaline or slightly acidic peat soil. The vegetation is usually rich in or dominated by sedges. Organic matter is often accumulated as peat within a fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than sphagnum mosses, such as sedges and brown mosses).

In general terms fens, like bogs, are peatlands, which are specialised terrestrial wetland ecosystems distinguished by the annual accumulation of peat (Wheeler 1984).

Fens, are usually peat-forming wetlands that receive mineral nutrients (magnesium, iron and in particular calcium) from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement, and are not generally so acidic as bogs. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species (Doyle & O Críodáin 2003, Sheehy Skeffington & O'Connell 1998).

Ecologically, a fen is a mineral rich freshwater environment in which dead but undecayed plant matter has accumulated to the point where most or all of the remaining vegetation is emergent (Rieley & Page 1990).

Fens differ from bogs because they are less acidic and have relatively higher mineral levels. They are therefore able to support a much more diverse plant and animal community.

Some contain a rich selection of higher plants; up to and occasionally more than half Ireland's species of dragonflies, several thousand other insect species, as well as being an important habitat for a range of invertebrates and birds.

Fens, like bogs, provide important benefits in a watershed, including preventing or reducing the risk of floods, improving water quality, and providing habitat for unique plant and animal communities.

Fens often occur in mosaics with other wetland communities such as reed beds, bogs or open water in which case they may be of relatively limited extent. Although fens can be found as discrete habitats in their own right, in relation to the 6 fen types being examined under the NPWS Fen Study, they may also occur in association with (or within) a range of other habitats including blanket bog, raised bog, turlough, dune slack, machair, wet heathland, wet grassland, woodland, karst areas, lacustrine and riverine habitats and systems.

The variation in the habitats in which fens occur highlight some immediate problems associated with what an ecologist / surveyor/ layman means when they describe a habitat as being a "fen".

This difficulty is caused by the inherent variability of factors governing the ecological processes in a fen - partial or wholly covered in water; mineral rich to mineral poor; relatively acid to alkaline pH; dominated in the moss layer by brown or Sphagnum moss species and usually forming at least some peat. These issues reflect the diversity and

continuity of habitat and vegetation types collectively called "fen", which may often lead to confusion when attempting to classify fen communities.

A fen is often a mosaic of different habitats ranging from open-water, reedbeds, small sedge vegetation, to semi-terrestrial birch and alder woodland. The complex of habitats that can occur within a fen contributes to the rich diversity of plants and animals.

As fens are an early successional stage in the formation of raised and in some cases blanket bogs, or occurred at the edges of such acid peatlands, they have experienced a natural decline in area as these more acid peatlands developed and eventually buried them (Rieley & Page 1990).

More recently, like most peatland types in Ireland, fens have experienced a decline in area, mostly from peat mining activities, draining for cropland, fuel extraction, and fertiliser pollution and eutrophication. Because of the large historical loss of this ecosystem type, the remaining fens are that much rarer, and it is crucial to protect a representative selection of the best examples of each (Foss et al. 2001, Crushell 2000).

Fens are important wetland systems, whose conservation value has been recognised by the EU Habitats Directive as Special Areas of Conservation (SACs) in both priority and non-priority habitat categories; as Wetlands of International Importance under the Ramsar Convention; and as Special Protection Areas (SPAs) under the EU Birds Directive. A number of the larger fens in Ireland are managed as National Nature Reserves or occur within National Parks.

4. Classification systems for Irish Fens

Irish Fens have been classified using a number of different schemes based on a variety of ecological factors including the peat type on which they occur, features and composition of their surface vegetation, hydrological conditions and their topographic location.

A number of the most popular fen classification schemes used are reproduced here, to demonstrate how the classification systems differ and relate to one another, and introduce the reader to the features and terms used in relation to the classification and description of Irish fens.

In addition the classification system used by the EU Habitats Directive is included for four of the six habitats which are being investigated under the current NPWS Irish Fen Study.

4.1 Fen topography and hydrological classification scheme

Irish Fens may be divided into two major groups based upon the topographic and hydrological conditions prevailing. These are topogenous fens and soligenous fens.

4.1.1 Topogenous Fens

These are formed where the topography results in a basin-type water collection system with little water movement out of the system and water fluctuations are in a vertical direction, as in shallow depressions, or in transitional zones of vegetation bordering open waters.

There are three main types of topogenous fen recognised in Ireland (Crushell 2000; Sheehy-Skeffington & O'Connell 1998; Ratcliffe 1977):

1 Open-water transition fens form on lake edges, where they occur on the landward side of the emergent reed vegetation which occurs further out into deeper water areas. They are one of the most common fen type found in Ireland. They occur predominantly in the limestone regions of Ireland and can be extensive. An example of such fens would be those around Lough Corrib, Co. Galway.

2 Flood plain fens occur on a waterlogged flood-plains adjacent to rivers or streams. They occur in depressions or low lying areas within the floodplain where still-standing water allows development of fen vegetation. This fen type is very rare in Ireland as many sites have disappeared as a result of arterial drainage. An example of such fens would be those alongside the River Shannon and its tributaries.

3 Basin fens form in waterlogged basins where there is little through flow of water, and open water may be present. These fens often support a floating raft of vegetation known as a Schwingmoor. These fens rare in Ireland as most sites which originally conformed to this fen type have developed into raised bogs as peat continued to accumulate. They mainly occur in the Irish midlands. An example of such a fen would be at Scragh Bog, Co. Westmeath.

4.1.2 Soligenous Fens

These are formed on sloping terrain where an adequate supply of water provides a continuous through flow of water. Smaller areas of soligenous fen may also occur within bogs or mires associated with routes of moving drainage water.

There are three main types of soligenous fens recognised in Ireland (Crushell 2000; Sheehy-Skeffington & O'Connell 1998; Ratcliffe 1977):

1 Valley Fens develop on the floor of shallow valleys. The slope within these fens may be

very gentle and water movement may not be immediately apparent. The main source of water would be from springs and seepage from the surrounding valley which is usually calcium rich. Valley fens are rare and occur mainly in the eastern part of the country. The combination of calcium rich water input and low annual rainfall amounts may help explain why these fens have not developed into raised bogs in the eastern part of the country (Sheehy-Skeffington & O'Connell 1998). An example of such a fen would be Pollardstown Fen, County Kildare.

2 Flush Fens occur as small areas within other fen and peatland types, such as raised or more typically blanket bogs. Within these areas the localised flow of water supplies more minerals than are found in the surrounding peatland areas which results in the development of floristically and visually identifiable areas of fen vegetation. In certain cases unusual communities of plants are found in these flush fens, more typical of arctic conditions (Lockhart 1999). This fen type is widespread within blanket bog areas of the West of Ireland. An example of such a fen would be at Uggool, Co. Mayo.

3 Calcareous Spring Fens develop around permanent freshwater springs or areas of seepage that are especially rich in calcium. The up welling of water is often associated with an interface between permeable and impermeable rock or soil strata. The water feeding these fens wells up from the ground and often deposits a white calcareous crust known as tufa on the above ground vegetation. Spring fen sites are often very limited in extent and often occur within larger fen systems or completely unrelated habitats e.g. woodlands, or exposed rocky terrain. These fens are rare in Ireland. Examples of such spring fens would be those found on Pollardstown Fen, County Kildare; Errisbeg, County Galway; and Ballyman Glen, County Wicklow.

4.1.3 Rich and Poor Fens

Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "rich fen", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich). A classic plant of rich fen is Saw-sedge (*Cladium mariscus*).

As we have seen from the definition of "fen" above, fens can also occur in sites with much lower mineral inputs (e.g. blanket bog) and a correspondingly higher acidity. Such areas may be described as "poor fen" and are commonly characterised by extensive development of *Sphagnum* moss carpets.

This variation and often imprecision of terminology has been examined by Wheeler & Proctor (2000), who make a number of recommendations. In examining a wide range of mire types they find a bimodal distribution of pH that backs up the rather vague existing concepts of "fen" and "bog". They consider fen to be defined by a pH generally above 6.0 and with relatively high levels of calcium and bicarbonate ions. The vegetation of such mires tends to be rich in herbs and 'brown mosses' (they cite *Drepanocladus*, *Campyllum* and *Scorpidium*, and *Cratoneuron* also should be included).

By contrast, bog is defined by a pH generally below 5.0, with low levels of calcium ions, and with chloride and sulphate ions as the main anions. Vegetation includes members of the heather family (*Calluna*, *Erica* etc.), cotton-grasses (*Eriophorum*) and other calcifuge ("calcium-avoiding") members of the sedge family, and often an abundance of *Sphagnum* mosses.

Using this definition, many examples of so-called "poor fen" or "acid fen" are better considered as "bog" and this gives a more satisfactory treatment of phases and micro topography in complex acid mire systems.

Although this is an interesting concept, it is not one adopted in the present study where poor fen is recognised as a fen vegetation type rather than a bog vegetation type.

4.2 EU Habitats Directive Annex 1 classification scheme

The EU Habitats Directive(92/43/EEC) was transposed into Irish law in the European Union (Natural Habitats) Regulations, 1997. These Regulations have since been amended twice with under Statutory Instrument SI 233/1998 and SI 378/2005. The Directive lists (in Annex I) certain habitats that must be protected within Special Areas of Conservation (SACs). Under the various habitats listed in Annex 1 of the Directive, four fen types are listed which occur in Ireland.

The Habitats Directive interpretation manual of European Union habitats, Version EUR 15 (Rameo 1996) lists the following fen types found in Ireland for which Ireland was to select a representative sample of conservation worthy sites. Habitat type 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* and 7220 * Petrifying springs with tufa formation (Cratoneurion) are both listed as priority habitats requiring the highest level of conservation within member states.

The following is an abstracts from EU Habitats Directive Interpretation Manual for the 4 fen types listed in the Directive and occurring in Ireland:

7140 Transition mires and quaking bogs

PAL.CLASS.: 54.5

1) Peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, with characteristics intermediate between soligenous and ombrogenous types. They present a large and diverse range of plant communities. In large peaty systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedges, associated with sphagnum or brown mosses. They are generally accompanied by aquatic and amphibious communities. In the Boreal region this habitat type includes minerotrophic fens that are not part of a larger mire complex, open swamps and small fens in the transition zone between water (lakes, ponds) and mineral soil.

These mires and bogs belong to the *Scheuchzerietalia palustris* order (oligotrophic floating carpets among others) and to the *Caricetalia fuscae* order (quaking communities). Oligotrophic water-land interfaces with *Carex rostrata* are included.

2) Plants: *Eriophorum gracile*, *Carex chordorrhiza*, *Carex lasiocarpa*, *Carex diandra*, *Carex rostrata*, *Carex limosa*, *Scheuchzeria palustris*, *Hammarbya paludosa*, *Liparis loeselii*, *Rhynchospora alba*, *R. fusca*, *Menyanthes trifoliata*, *Epilobium palustre*, *Pedicularis palustris*, *Sphagnum* sp. (*S. papillosum*, *S. angustifolium*, *S. subsecundum*, *S. fimbriatum*, *S. riparium*, *S. cuspidatum*, *Calliergon giganteum*, *Drepanocladus revolvens*, *Scorpidium scorpioides*, *Campyllum stellatum*, *Aneura pinguis*.

3) Corresponding categories

United Kingdom classification: "M4 - *Carex rostrata*-*Sphagnum recurvum* mire", "M5 - *Carex rostrata*- *Sphagnum squarrosum* mire", "M8 - *Carex rostrata*-*Sphagnum warnstofii* mire", "M9 *Carex rostrata*-*Calliergon cuspidatum/giganteum*", "S27 -*Carex rostrata* - *Potentilla palustris* fen".

7210 *Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae

PAL.CLASS.: 53.3

1) *Cladium mariscus* beds of the emergent-plant zones of lakes, fallow lands or succession stage of extensively farmed wet meadows in contact with the vegetation of the Caricion davallianae or other Phragmition species [*Cladietum marisci* (Allorge 1922) Zobrist 1935].

2) Plants: *Cladium mariscus*, *Kosteletzkiya pentacarpos*.

3) Corresponding categories

United Kingdom classification: "S2 *Cladietum marisci*", "S24 Peucedano - *Phragmitetum australis*", "S25 *Phragmites australis* - *Eupatorium cannabinum* fen", "M9 *Carex rostrata*-*Calliergon* spp. mire", "M13 *Schoenus nigricans* - *Juncus subnodulosus* mire", "M14 *Schoenus nigricans* - *Narthecium ossifragum* mire", "M24 *Molinia caerulea* - *Cirsium dissectum* fen meadow", "SD 14 *Salix repens* - *Campylium stellatum* dune slack" and "SD 15 *Salix repens* - *Calliergon cuspidatum* dune slack".

4) In contact with calcareous fens (7230), but also with acid fens, extensive wet meadows, other reed beds and tall sedge communities.

7220 * Petrifying springs with tufa formation (*Cratoneurion*)

PAL.CLASS.: 54.12

1) Hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (*Cratoneurion commutatum*).

2) Plants: *Arabis soyeri*, *Cochlearia pyrenaica* (in sites with heavy metals), *Pinguicula vulgaris*, *Saxifraga aizoides*. Mosses: *Catocopium nigratum*, *Cratoneuron commutatum*, *C. commutatum* var. *falcatum*, *C. filicinum*, *Eucladium verticillatum*, *Gymnostomum recurvirostrum*. In the Boreal region also *Carex appropinquata*, *Epilobium davuricum*, *Juncus triglumis*, *Drepanocladus vernicosus*, *Philonotis calcarea*, *Scorpidium revolvens*, *S. cossoni*, *Cratoneuron decipiens*, *Bryum pseudotriquetum*.

3) Corresponding categories

United Kingdom classification: "M37 *Cratoneuron commutatum* - *Festuca rubra* spring community" and "M38 *Cratoneuron commutatum*-*Carex nigra* spring community".

4) Can form complexes with transition mires, fens, chasmophytic communities of cold and humid environments and heaths and calcareous grassland (*Festuco-Brometalia*). In order to preserve this habitat of very limited expanse in the field, it is essential to preserve its surroundings and the whole hydrological system concerned.

7230 Alkaline fens

PAL.CLASS.: 54.2

1) Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other Cyperaceae usually dominate the mire communities, which belong to the *Caricion davallianae*, characterised by a usually prominent "brown

moss" carpet formed by *Campyllum stellatum*, *Drepanocladus intermedius*, *D. revolvens*, *Cratoneuron commutatum*, *Acrocladium cuspidatum*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others, a grasslike growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Scirpus cespitosus*, *Eleocharis quinqueflora*, and a very rich herbaceous flora including *Tofieldia calyculata*, *Dactylorhiza incarnata*, *D. traunsteineri*, *D. traunsteinerioides*, *D. russowii*, *D. majalis* ssp. *brevifolia*, *D. cruenta*, *Liparis loeselii*, *Herminium monorchis*, *Epipactis palustris*, *Pinguicula vulgaris*, *Pedicularis sceptrum - carolinum*, *Primula farinosa*, *Swertia perennis*.

Wet grasslands (*Molinietalia caerulea*, e.g. *Juncetum subnodulosi* & *Cirsietum rivularis*, 37), tall sedge beds (*Magnocaricion*, 53.2), reed formations (*Phragmition*, 53.1), fen sedge beds (*Cladietum mariscae*, 53.3), may form part of the fen system, with communities related to transition mires (54.5, 54.6) and amphibious or aquatic vegetation (22.3, 22.4) or spring communities (54.1) developing in depressions. The sub-units below, which can, alone or in combination, and together with codes selected from the categories just mentioned, describe the composition of the fen, are understood to include the mire communities *sensu stricto* (*Caricion davalliana*), their transition to the Molinion, and assemblages that, although they may be phytosociologically referable to alkaline Molinion associations, contain a large representation of the *Caricion davalliana* species listed, in addition to being integrated in the fen system; this somewhat parallels the definition of an integrated class *Molinio - Caricetalia davalliana* in Rameau et al., 1989. Outside of rich fen systems, fen communities can occur as small areas in dune slack systems (16.3), in transition mires (54.5), in wet grasslands (37), on tufa cones (54.121) and in a few other situations. The codes below can be used, in conjunction with the relevant principal code, to signal their presence. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. They are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most.

2) Plants: *Schoenus nigricans*, *S. ferrugineus*, *Carex* spp., *Eriophorum latifolium*, *Cinclidium stygium*, *Tomentypnum nitens*.

4.3 CORINE fen classification scheme

The CORINE biotopes project was carried out during the period 1985-90 by a group of European experts working under the guidance and in close co-operation with the CORINE central team at the Directorate-General for the Environment, Nuclear Safety and Civil Protection of the European Commission.

The absence of comprehensive, complete and compatible information on the environment across the Community as a whole was a major impediment to the development of an effective Community environmental policy.

In response to this need, the Commission realised a series of preparatory works which led the Council to adopt a decision on a Commission work programme - the CORINE programme - concerning an "experimental project for gathering, co-ordinating and ensuring the consistency of information on the state of the environment and natural resources in the Community" (European Communities, 1985).

The CORINE programme was based on a series of priorities including compiling an inventory of biotopes of major importance for nature conservation in the Community (to which the NPWS submitted a series of Irish site records); and work on the availability and comparability of data.

This involved the production of a CORINE biotopes manual, which included a list of habitats of the European Community to act as a guide to the consistent identification and classification of sites of major conservation importance.

This manual lists the following habitats types, a brief description of which is presented here, that have a relevance to this NPWS Fen Study, as a series of Irish fen sites submitted to the CORINE program, were classified under these categories. A full account of these habitats can be found in the CORINE Manual (Anonymous 1991). These fen communities include the following:

53.3 - Fen sedge beds

Cladium mariscus dominated formations, mostly limited in the northern part of their range, where they have a distinct relict distribution, to alkaline and sometimes acid fens and to the land-building zone of calcareous lakes.

53.31 - Fen *Cladium* beds

Species rich, fairly open *Cladium mariscus* beds of alkaline and sometimes acid fens, accompanied by corteges of the Caricion *davallianae* or of the Caricion *lasiocarpae*. These formations are in grave decline throughout their range.

54 - Fens, transition mires and springs

Small sedge and related communities of fens, transition mires and quaking bogs; vegetation of springs.

54.1 - Springs Montio-Cardaminetea

Gushing springs, spring basins and seepages and the communities closely associated with them and dependent on the peculiar micro climatic and hydrological situations created by springs. These comprise the specialised spring communities (Montio-Cardaminetea) as well as the fen communities (*Caricetalia davallianae* 54.2, *Caricetalia fuscae* 54.4) or other communities (*Caricion bicoloris-atrofuscae* 54.3, *Festuco-Brometea* 34.3) that are interwoven with them.

54.11 - Soft water springs Montio-Cardaminetea

Spring communities of waters poor in lime dominated by bryophytes, mostly characteristic of northern upland and high montane, alpine or sub alpine levels. Also locally of well-lit lowland sites. The principal mosses that compose them are *Philonotis fontana*, *P. seriata*, *Anthelia julacea*, *Pohlia wahlenbergii*, *Scanapia paludosa*, *Bryum schleicheri*, *Sphagnum auriculatum*. A few small vascular plants accompany them, in particular *Montia fontana*, *Saxifraga stellaris*, *S. rivularis*, *S. aquatica*, *Cerastium cerastoides*, *Epilobium anagallidifolium*.

54.12 - Hard water springs Cratoneurion (Tufa and calcareous)

Calcareous, often petrifying, springs. Their specialised communities, usually dominated by bryophytes, belong to the Cratoneurion commutati. Characteristic species are the mosses *Cratoneuron filicinum*, *C. commutatum*, *C. commutatum var. falcatum*, *Eucladium verticillatum* inter alia with *Equisetum telmateia*, *E. variegatum*, and flowering plants including *Pinguicula vulgaris* and *Saxifraga aizoides*.

Larger petrifying springs form tufa cones that constitute singular habitats with several interacting plant and animal communities (Codes 54.122 & 54.122).

54.2 - Rich fens Caricion davallianae

Wetlands mostly or largely occupied by peat - or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, nutrient-poor, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other Cyperaceae usually dominate the mire communities, which belong to the Caricion davallianae, characterised by usually prominent "brown moss" carpet formed by *Campylium stellatum*, *Drepanocladus intermedius*, *D. revolvens*, *Cratoneuron commutatum*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others. With a grasslike growth of *Schoenus nigricans*, *Eriophorum latifolium*, *Carex flava*, *C. Lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus* inter alia.

54.21 - Black bog rush fens

Schoenus nigricans dominated or *Schoenus* rich communities, of wide distribution. Rushes and *Juncus subnodulosus* in British and western continental inland fens. Other accompanying species include: *Carex lepidocarpa*, *C. hostiana*, *C. panicea*, *C. pulicaris*, *Eriophorum latifolium*, *Molinia caerulea*, *Dactylorhiza incarnata*, *D. traunsteineri*, *Epipactis palustris*, *Parnassia palustris*, *Pinguicula vulgaris*, brown mosses and, locally *Pinguicula lusitana* and *Drosera anglica*.

54.22 - Brown bog rush fens

Non *Schoenus* dominated fens with similar accompanying species to 54.21 above.

54.4 - Acidic fens

Topogenous or soligenous valley, basin or spring mire systems fed by waters poor in bases. As in rich fens the water is at or near the surface of the substratum and peat formation is infra-aquatic. The mire communities themselves, dominated by small sedges and brown mosses or *Sphagnum*, belong to the Caricetalia fuscae, but, in larger fen systems, they are accompanied by acidocline wet grassland (Molinietales), large sedge (Magnocaricion) and reed or related communities (Phragmition). *Sphagnum* hummocks form locally and transition mire, aquatic and spring communities may occur in small depressions. Acidic fen communities also occur on small surfaces or within mosaics in other communities including humid grasslands, humid woodlands, decalcified dune slacks, and spring systems.

Characteristic species include *Carex nigra*, *C. echinata*, *Eriophorum angustifolium*, *Scirpus cespitosus*, *Agrostis canina*, *Viola palustris*, *Cardamine pratensis*, *Ranunculus flammula*, *Juncus spp.* and mosses *Calliergon stramineum*, *C. cuspidatum*, *Drepanocladus exannulatus*, *Sphagnum recurvum*, *S. subsecundum*, *S. russowii*, *S. papillosum* inter alia.

54.5 - Transition mires

Wetlands mostly or largely occupied by peat-forming plant communities developed at the surface of oligotrophic or meso-oligotrophic water reaching a level above, sometimes well above, the substratum, providing little or no mineral nutrient supply. Their characteristics are thus intermediate between those of soligenous and topogenous mires and those of strictly ombrogenous bogs. In large systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium sized or small sedges, associated with *Sphagnum* or brown mosses. Transition mires form mostly as colonists of oligotrophic ponds and lakes, large bog pools or lagg zones.

Outside of transition mire systems, their communities can be found in bog hollows, blanket bogs, depressions of rich or poor acidic fens, spring systems, humid heaths inter alia.

Characteristic species include *Eriophorum gracile*, *Carex lasiocarpa*, *C. chordorrhiza*, *C. limosa*, *Hammarbya paludosa*.

4.4 Heritage Council classification scheme for fens and related wetlands

The Heritage Council Guide to habitats in Ireland (Fossitt 2000) sets out a standard hierarchical scheme for the identification of habitats in Ireland. The guide lists the main fen habitats in Ireland under the category of peatlands and freshwater. The guide is a practical tool to allow identification and recording of habitat types.

The 5 specific descriptions which most closely relate to those being recorded in the present NPWS Fen Study are reproduced for information here, namely:

Level 1 Category: Peatlands (P)
Level 2 Categories: Fens & Flushes (PF)
Level 3 Categories:
Rich fen and flush PF1
Poor fen and flush PF2
Transition mire and quaking bog PF3

Level 1 Category: Freshwater (F)
Level 2 Categories: Springs (FP)
Level 3 Categories:
Calcareous springs FP1
Non-calcareous springs FP2

One category of Fossitt namely Rich fen and flush PF1, corresponds to two of the categories being investigated in this study namely Alkaline fens (7230) and Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (7210).

In addition to the descriptions of habitats that most closely relate to those of interest to this NPWS Fen Study, descriptions are also provided in this section for a number of related wetland habitats which may often be confused with "fen" vegetation as defined in this study. These habitats are Freshwater Marsh GM1; Wet grassland GS4; Reed and large sedge swamps FS1; Tall-herb swamps FS2.

The descriptions below are taken from Fossitt (2000) with some minor corrections and changes to the text.

Peatlands (P)

Fossitt (2000) describes fens as "peat-forming systems that differ from bogs in that they are fed by groundwater or moving surface waters. They occur in river valleys, poorly drained basins or hollows, and beside open stretches of water (lake margins or river flood plains). Fens may also be associated with the fringes or other parts of acid bogs where there is enrichment of the water supply."

Any areas of fen that have been modified by turf cutting should be considered under cutover bog - PB4. Flushes are usually smaller features that are maintained by the movement or seepage of water. They occur on slopes and may or may not be peat-forming. Some flushes feed into fens while others may be associated with a range of different habitat types including bogs, woodlands and grasslands. Flushes in bogs are usually characterised by changes in the vegetation that are brought about by an enhanced supply of nutrients. Note that springs are considered in the freshwater section (FP1-2) (see below).

Fens and flushes (PF) are divided into 'rich' (basic) and 'poor' (acid) types depending on the origin and nature of the water supply. A third category, transition mire and quaking bog - PF3, is also distinguished because it has vegetation characteristics that are intermediate between rich and poor fen categories.

Rich fen and flush PF1

Rich fens and flushes are fed by groundwater or flowing surface waters that are at least mildly base-rich or calcareous, and are usually found over areas of limestone bedrock. The substratum is waterlogged peat (except in the case of some flushes) and this usually has a high mineral content. Vegetation is typically dominated by Black Bog-rush (*Schoenus nigricans*) and/or small to medium sedges such as *Carex viridula*, *C. nigra*, *C. dioica* and *C. panicea*. Other prominent components of the vegetation include rushes, particularly Blunt-flowered Rush (*Juncus subnodulosus*), Purple Moor-grass (*Molinia caerulea*), Marsh Pennywort (*Hydrocotyle vulgaris*), Lesser Spearwort (*Ranunculus flammula*), Water Mint (*Mentha aquatica*), Common Marsh-bedstraw (*Galium palustre*), Grass-of-parnassus (*Parnassia palustris*), Common Butterwort (*Pinguicula vulgaris*) and Devil's-bit Scabious (*Succisa pratensis*). Rich fen and flush can be important for orchids such as *Epipactis palustris* and *Dactylorhiza* spp. A well-developed moss layer with *Campyllum stellatum*, *Scorpidium scorpioides* and *Drepanocladus revolvens* is also characteristic. The tops of Black Bog-rush (*Schoenus nigricans*) tussocks are relatively dry and may support plants such as heathers (*Calluna vulgaris*, *Erica tetralix*), Tormentil (*Potentilla erecta*), Bog-myrtle (*Myrica gale*) and Bog Asphodel (*Narthecium ossifragum*).

Rich fens and flushes may have some patchy cover of Common Reed (*Phragmites australis*), Bulrush (*Typha latifolia*), or tussock-forming species such as Great Fen-sedge (*Cladium mariscus*) and Greater Tussock-sedge (*Carex paniculata*). If large areas are dominated by species-poor or mono dominant stands of tall herbaceous plants, they should be considered under reed and large sedge swamps - FS1. Fens may contain patches of scrub or woodland, or bodies of open water with aquatics such as Bogbean (*Menyanthes trifoliata*). If the surface is quaking and very wet, and the vegetation comprises some species that may also be found in acid bogs, consider the category transition mire and quaking bog - PF3.

Links with EU Habitats Directive Annex I: This category corresponds to two annexed habitats, 'alkaline fens (7230)' and '*Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae (7210)'. The latter is a priority habitat that describes stands of species-rich alkaline fen vegetation in which Great Fen-sedge (*Cladium mariscus*) is dominant.

Poor fen and flush PF2

This category includes peat-forming fens and flushes that are fed by groundwater or flowing surface waters that are acid. Flushes that are acidic but not peat-forming should also be considered here. In most cases the substratum is acid peat which has a higher nutrient status than that of ombrotrophic bogs. The vegetation of poor fens and flushes is typically dominated by sedges (particularly *Carex rostrata*, *C. nigra*, *C. curta*, *C. lasiocarpa* and *C. echinata*) and/or rushes (*Juncus effusus*, *J. articulatus*, *J. acutiflorus*). Other common components include Common Cottongrass (*Eriophorum angustifolium*), Velvet Bent (*Agrostis canina*), Purple Moor-grass (*Molinia caerulea*), Yorkshire-fog (*Holcus lanatus*) and broad-leaved herbs such as Marsh Violet (*Viola palustris*), Bogbean (*Menyanthes trifoliata*), Heath Bedstraw (*Galium saxatile*), Tormentil (*Potentilla erecta*) and Marsh Cinquefoil (*Potentilla palustris*). There may be some limited cover of dwarf shrubs. Extensive carpets of mosses including, in particular, *Sphagnum palustre*, *S. recurvum*, *S. auriculatum*, *Calliergon stramineum* and *Polytrichum commune*, are characteristic.

Although poor fen and flush is not listed in Annex I of the Habitats Directive, it is very limited in extent in Ireland and should be regarded as being of special conservation importance (C. Ó Críodáin, pers. comm.).

Transition mire and quaking bog PF3

Transition mires and quaking bogs are extremely wet peat-forming systems with characteristics that are intermediate between poor and rich fens. For this reason, they are considered as a separate habitat but they may occur within, or on the fringes of other peat-forming systems. Transition mires and quaking bogs are usually associated with the wettest parts of a bog or fen and can be found in wet hollows, infilling depressions, or at the transition to areas of open water. Vegetation frequently forms a floating mat or surface scraw over saturated, spongy or quaking peat. Standing water may occur in pools or along seepage zones. The vegetation typically comprises species that are characteristic of bog, fen and open water habitats. Small to medium sedges, mainly *Carex* spp. (particularly *Carex diandra*, *C. lasiocarpa*, *C. limosa* and *C. viridula*), usually dominate and may occur together with White Beak-sedge (*Rhynchospora alba*), cotton grasses (*Eriophorum angustifolium*, and the much rarer *E. gracile*), Creeping Bent (*Agrostis stolonifera*), Purple Moor-grass (*Molinia caerulea*), and a range of broad-leaved wetland herbs such as Bogbean (*Menyanthes trifoliata*), Marsh Pennywort (*Hydrocotyle vulgaris*), Lesser Spearwort (*Ranunculus flammula*), Marsh Cinquefoil (*Potentilla palustris*) and Marsh Lousewort (*Pedicularis palustris*). Extensive moss cover is characteristic; *Sphagnum* spp., *Calliergon* spp. and *Scorpidium scorpioides* are usually abundant.

Links with EU Habitats Directive Annex I: Corresponds to the annexed habitat, 'Transition mires and quaking bogs (7140)'

Springs (FP)

Springs are usually very small local features that are maintained by a more or less continual supply of water from upwelling groundwater sources, or along seepage zones. They occur in upland and lowland areas and may be associated with a variety of different habitat groups such as woodland, heath, grassland or exposed rock. Springs are characterised by abundant mosses and may or may not be peat-forming.

Calcareous springs FP1

This category is used for springs that are irrigated and kept permanently moist by water that is calcareous and oligotrophic. These springs may be associated with shallow peaty or skeletal mineral soils. There may be some precipitation of marl, or tufa formation. Calcareous springs are typically dominated by mosses, and by *Cratoneuron* spp. in particular; *Bryum pseudotriquetrum* is also characteristic. Other common components of the vegetation include grasses (*Festuca rubra*, *Briza media*), sedges (*Carex dioica*, *C. pulicaris*, *C. flacca*, *C. nigra*), Common Butterwort (*Pinguicula vulgaris*) and Marsh Horsetail (*Equisetum palustre*). The relatively rare Yellow Saxifrage (*Saxifraga aizoides*) can occur in calcareous springs and is diagnostic of this habitat.

Links with EU Habitats Directive Annex I: Calcareous springs with tufa formation are recognised as the priority habitat, '*Petrifying springs with tufa formation (*Cratoneurion*) (7220)'.

Non-calcareous springs FP2

This category is used for springs that are irrigated and kept permanently moist by acidic to neutral water that is base-poor and typically oligotrophic. They may be associated with skeletal mineral or peaty soils. Vegetation is typically dominated by mosses (particularly *Sphagnum auriculatum*, *Calliergon samentosum* and *Polytrichum commune*), grasses (*Agrostis* spp., *Deschampsia caespitosa*, *Nardus stricta*), Bulbous Rush (*Juncus bulbosus*), and wetland species such as Marsh Violet (*Viola palustris*), Lesser Spearwort (*Ranunculus flammula*) and Marsh Pennywort (*Hydrocotyle vulgaris*).

Other wetland habitats that may be found in association with fens

Marsh

Freshwater Marsh GM1

Marsh is found on level ground near river banks, lake shores, and in other places where mineral or shallow peaty soils are waterlogged, and where the water table is close to ground level for most of the year. Unlike swamps, standing water is not a characteristic feature except, perhaps, during very wet periods or in winter months. Marsh is comparatively species-rich and supports a high proportion of wetland species in addition to the typical dominants: rushes (*Juncus* spp.), sedges (*Carex* spp.) and Meadow sweet (*Filipendula ulmaria*). Grasses such as Creeping Bent (*Agrostis stolonifera*), Tall Fescue (*Festuca arundinacea*) and Purple Moor-grass (*Molinia caerulea*) may be present but not abundant. To be considered as marsh, the proportion of sedges and grasses should not exceed 50%. The broad-leaved herb component may include Water Mint (*Mentha aquatica*), Marsh Thistle (*Cirsium palustre*), Wild Angelica (*Angelica sylvestris*), Marsh Pennywort (*Hydrocotyle vulgaris*), Marsh-marigold (*Caltha palustris*), Common Valerian (*Valeriana officinalis*), Ragged-robin (*Lychnis flos-cuculi*), Purple-loosestrife (*Lythrum salicaria*), Marsh Woundwort (*Stachys palustris*) and Marsh Cinquefoil (*Potentilla palustris*). Marsh may also support horsetails (*Equisetum* spp.), Yellow Iris (*Iris pseudacorus*), reeds and other large grasses and sedges but these should not dominate. Herbs that are characteristic of drier ground are rare or absent in marshes. Mosses, particularly *Calliargon* and *Climacium* spp., may be plentiful.

Marsh differs from swamps in that the vegetation is usually more species-rich, standing water is absent for much of the year, and reeds and other tall or bulky grasses and sedges, and tall herbs are not overwhelmingly dominant in the former. The distinction between marsh and wet grassland - GS4 is less clear but, in marsh, wetland herbs should be prominent, and species of drier ground should generally be absent. If there is greater than 50% cover of grasses and sedges, the habitat should be considered under grassland or, if it is a peat-forming system, under fens and flushes. Marsh is not a peat-forming habitat.

Links with EU Habitats Directive Annex I: Marsh may contain pockets of the annexed habitat, 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'.

Grassland

Wet grassland GS4

This type of grassland can be found on flat or sloping ground in upland and lowland areas. It occurs on wet or waterlogged mineral or organic soils that are poorly-drained or, in some cases, subjected to seasonal or periodic flooding. On sloping ground, wet grassland is mainly confined to clay-rich gleys and loams, or organic soils that are wet but not waterlogged. This category includes areas of poorly-drained farmland that have not recently been improved, seasonally-flooded alluvial grasslands such as the River Shannon callows, and wet grasslands of turlough basins (See also turloughs - FL6).

Species composition varies considerably. Wet grassland often contains abundant rushes (*Juncus effusus*, *J. acutiflorus*, *J. articulatus*, *J. inflexus*) and/or small sedges (*Carex flacca*, *C. hirta*, *C. ovalis*), in addition to grasses such as Yorkshire-fog (*Holcus lanatus*), Creeping Bent (*Agrostis stolonifera*), Marsh Foxtail (*Alopecurus geniculatus*), Rough Meadow-grass (*Poa trivialis*) and Tufted Hair-grass (*Deschampsia caespitosa*). Purple Moor-grass (*Molinia caerulea*) may also be present but should not dominate. The proportion of broad-leaved herbs is often high; those that commonly occur in wet grassland include Creeping Buttercup (*Ranunculus repens*), Marsh Thistle (*Cirsium palustre*), Silverweed (*Potentilla*

anserina), Meadow sweet (*Filipendula ulmaria*), Water Mint (*Mentha aquatica*), Common Marsh-bedstraw (*Galium palustre*), Devil's-bit Scabious (*Succisa pratensis*), Lesser Spearwort (*Ranunculus flammula*) and Cuckoo flower (*Cardamine pratensis*). Other common broad-leaved herbs that occur on drier grasslands may also be present, depending on the degree of wetness. Wet grassland may be important for orchids such as Spotted-orchid (*Dactylorhiza maculata*). Horsetails (*Equisetum* spp.), Yellow Iris (*Iris pseudacorus*), Floating Sweet-grass (*Glyceria fluitans*) and clumps of tall reeds may be locally abundant.

Wet grassland frequently grades into marsh - GM1 and there are many similarities in the range of species present in both habitats. To be included in the wet grassland category, the cover of grasses should exceed 50%, except in areas where rushes or small sedges predominate, and the total cover of reeds, large sedges and broad-leaved herbs should be less than 50%. Among the suite of broad-leaved herbs that are present, there should be a significant proportion of drier grassland species in addition to those that are more commonly associated with wetlands.

Links with EU Habitats Directive Annex I: Wet grassland may contain examples of the annexed habitat, 'Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (6410)'.

Swamps

Swamps are stands of emergent herbaceous vegetation that generally occupy a zone at the transition from open water to terrestrial habitats. Water levels may fluctuate but swamps typically remain wet with the water table above ground level for most of the year. They can be associated with freshwater or brackish systems, and the water may be stagnant, slow-moving or tidal. Swamps occur along the margins of rivers, lakes, canals, lagoons and estuaries, but may also occupy more extensive flooded areas or infilling basins. Some swamps occur as floating mats of vegetation.

Reed and large sedge swamps FS1

This category includes species-poor stands of herbaceous vegetation that are dominated by reeds and other large grasses or large, tussock-forming sedges. Most reed and large sedge swamps are overwhelmingly dominated by one or a small number of species, as in the case of reed beds. Stands of vegetation can range from very dense to open. Typical components include Common Reed (*Phragmites australis*), Common Club-rush (*Schoenoplectus lacustris*), Reed Sweet-grass (*Glyceria maxima*), Branched Bur-reed (*Sparganium erectum*), Reed Canary-grass (*Phalaris arundinacea*), Great Fen-sedge (*Cladium mariscus*), Greater Tussock-sedge (*Carex paniculata*), Bulrush (*Typha latifolia*) and Water Horsetail (*Equisetum fluviatile*). Stands of Sea Club-rush (*Bolboschoenus maritimus*) may also occur in brackish waters. Note that a number of the possible dominants have a late growing season and their full extent may be difficult to determine before mid-May. Unlike tall-herb swamps - FS2 below, the broad-leaved herb component is minor. Vegetation typically lacks stratification as there is little or no development of an under storey element. In some situations there may be a mixture of other species such as Common Marsh-bedstraw (*Galium palustre*), Water Mint (*Mentha aquatica*), forget-me-nots (*Myosotis* spp.), Bogbean (*Menyanthes trifoliata*), Marsh Cinquefoil (*Potentilla palustris*), Wild Angelica (*Angelica sylvestris*), Meadow sweet (*Filipendula ulmaria*) or Fool's Water-cress (*Apium nodiflorum*).

Tall-herb swamps FS2

Tall-herb swamps are comparatively species-rich stands of herbaceous vegetation that occur in wet areas where the water table is above the ground surface for most of the year, or where water levels fluctuate regularly as in the case of tidal sections of rivers. Tall or robust broad-leaved herbs dominate and common components include Lesser Water-parsnip (*Berula erecta*), Fool's Water-cress (*Apium nodiflorum*), Gipsywort (*Lycopus*

europaeus), Brooklime (*Veronica beccabunga*), Hemlock Water-dropwort (*Oenanthe crocata*), Hemp-agrimony (*Eupatorium cannabinum*) and Water Forget-me-not (*Myosotis scorpioides*). These swamps may also support Yellow Iris (*Iris pseudacorus*), Water-plantain (*Alisma plantago-aquatica*) and Water Horsetail (*Equisetum fluviatile*), in addition to occasional reeds, large grasses (*Glyceria maxima*, *Festuca arundinacea*) and sedges. Cover of the latter should, at most, be patchy or dispersed; swamps that are dominated by reeds, and other large grasses or sedges should be considered under reed and large sedge swamps - FS1 above. Tall-herb swamps may have an under storey element with a range of smaller wetland plants.

Links with EU Habitats Directive Annex I: Tall-herb swamps can include pockets of the annexed habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'. In Ireland, however, stands of the latter are usually fragmented and poorly developed.

Woodland and Scrub

Wet willow-alder-ash woodland WN6

This broad category includes woodlands of permanently waterlogged sites that are dominated by willows (*Salix* spp.), Alder (*Alnus glutinosa*) or Ash (*Fraxinus excelsior*), or by various combinations of some or all of these trees. It includes woodlands of lake shores, stagnant waters and fens, known as carr, in addition to woodlands of spring-fed or flushed sites. Carr is dominated by Rusty Willow (*Salix cinerea* ssp. *oleifolia*) and Alder (*Alnus glutinosa*). The field layer comprises Creeping Bent (*Agrostis stolonifera*), Meadowsweet (*Filipendula ulmaria*), Common Marsh-bedstraw (*Galium palustre*), Purple-loosestrife (*Lythrum salicaria*) and Skullcap (*Scutellaria galericulata*). Mosses such as *Climacium dendroides*, *Calliergon cordifolium* and *Homalia trichomanoides* are characteristic. Carr occurs on organic soils and fen peats that are subject to seasonal flooding but remain waterlogged even when flood waters recede.

Woodlands of flushed or spring-fed sites are typically dominated by Alder (*Alnus glutinosa*) or Ash (*Fraxinus excelsior*) and the ground flora is often 'grassy' in appearance with abundant Remote Sedge (*Carex remota*) and Creeping Bent (*Agrostis stolonifera*). Other common components of the field layer include Bramble (*Rubus fruticosus* agg.), Creeping Buttercup (*Ranunculus repens*), Meadowsweet (*Filipendula ulmaria*), Common Marsh-bedstraw (*Galium palustre*), Yellow Pimpernel (*Lysimachia nemorum*) and Lady-fern (*Athyrium filix-femina*). This type of woodland occurs on mineral soils or fen peats, and may occasionally be associated with river banks or lake shores. Note that riparian woodland - WN5 is treated as a separate category.

Also included in this category are woodlands of calcareous spring-fed hollows that are characterised by a mixture of trees including willows (*Salix* spp.), Alder (*Alnus glutinosa*), Ash (*Fraxinus excelsior*) and Downy Birch (*Betula pubescens*). Greater Tussock-sedge (*Carex paniculata*) dominates the field layer and tussocks may support species of drier land. Common Reed (*Phragmites australis*) may be abundant in open wet areas. The ground surface is often treacherous and water-filled hollows and channels typically support aquatic plants.

Turloughs

Turloughs FL6

Turloughs are ephemeral lakes that occupy basins or depressions in limestone areas, and where water levels fluctuate markedly during the year. They are virtually unique to Ireland and their greatest concentration is in counties Clare, Galway and Roscommon. The general pattern is to flood in winter and dry out in summer, but there may be other sporadic rises in response to high rainfall. Turloughs normally fill through underground

passages and sinkholes but some also have inflowing rivers or streams. Some turlough basins retain standing water in channels, pools or small lakes when flooding subsides. All areas within the normal limit of flooding are considered as part of the turlough habitat. The presence of the distinctive dark moss, *Cinclidotus fontinaloides*, on stone walls or rocks can help to establish this level. Soils of turlough basins can include marls, peat, clays or loams. Large boulders or exposures of bedrock may also be present.

Turloughs support a range of different plant communities that comprise a mixture of aquatic, amphibious and terrestrial species. Plant communities typically form a concentric pattern around the basin; the different zones reflect differences in the extent

and duration of flooding. Wet grassland usually dominates and characteristic species include Creeping Bent (*Agrostis stolonifera*), small sedges (particularly *Carex nigra* and *C. panicea*), Silverweed (*Potentilla anserina*), Meadowsweet (*Filipendula ulmaria*), Creeping Buttercup (*Ranunculus repens*), Marsh Pennywort (*Hydrocotyle vulgaris*) and Amphibious Bistort (*Polygonum amphibium*). Permanent pools, channels and lakes may also be present and may support Common Spike-rush (*Eleocharis palustris*), Water-plantain (*Alisma plantago-aquatica*), pondweeds (*Potamogeton* spp.), and tall reeds such as Common Club-rush (*Schoenoplectus lacustris*).

Links with EU Habitats Directive Annex I: Corresponds to the priority habitat, '*Turloughs (3180)*'.

4.5 Previous NPWS fens & flushes classification scheme

As part of the National Areas of Scientific Interest, and the subsequent Natural Heritage Area survey undertaken by the NPWS, a classification scheme was introduced in 1993 (Lockhart et al 1993) to identify and systematise the recording of habitats occurring on conservation worthy sites in Ireland.

The habitat data on sites was further refined, to include a habitat area estimate, by assigning a 4 point cover rating scheme to each given habitat occurring on a site. The habitat cover categories used were: 1 <5%; 2 5-20%; 3 21-50%; 4 >50%.

The data collected was computerised and held within the NPWS sites database which was maintained from the period 1993-2005. This original habitat classification scheme was replaced by the Fossitt habitat classification scheme introduced by the Heritage Council (see above) in 2006, when a Fossitt re-classification or assignment was undertaken of all habitats recorded on sites within the NPWS site database.

Of interest to the present study is the original habitat category Fens and Flushes which is defined by the NPWS scheme as:

Fens are peatlands fed by calcium-rich water, either from groundwater or from inflowing surface water. Flushes are wet areas maintained by the seepage of water down slopes of various gradients, and are usually local features. Both are characterised by an abundance of small sedges (*Carex* spp.) forming species rich mosaics with other species, e.g. *Schoenus nigricans* (black bog rush), *Cladium mariscus* (saw sedge), *Succisa pratensis* (devils-bit scabious), *Potentilla palustris* (marsh cinquefoil), *Cirsium dissectum* (meadow thistle), *Anagallis tenella* (bog pimpernel), etc. Orchid species, such as *Epipactis palustris* (marsh helleborine), can be particularly noticeable in fens, and *Pinguicula* spp. (butterwort) noticeable in flushes. A well developed brown moss layer is also characteristic. Fens may contain open water bodies, often fringed with tall sedges or *Menyanthes trifoliata* (bog bean) and may support small patches of SCRUB or WET WOODLAND.

No further subdivision of the this habitat category was made within the NPWS computerised classification scheme. Additional information on the specific fen type(s) present on site, was sometimes recorded but only on the explanatory notes and site synopsis report to accompany the NHA or SAC site file.

4.6 Fen floristic and phytosociological classification

Fens can be conveniently classified on floristic grounds (due to chemistry) into rich (basic pH) and poor (acidic pH) fens as mentioned earlier in section 4.1. A summary overview of the phytosociological scheme for the classification of Irish fen vegetation is provided in Table: 4.6.1 (based on the classification scheme of Ó Críodáin & Doyle 1994, and White & Doyle 1982):

Table 4.6.1: Phytosociological classification scheme for Irish Fens

| |
|--|
| <p>SCHUCHZERIO-CARICETEA (synonym PARVOCARICETEA) (<u>Small sedge vegetation of swamps, rheotrophic mires, calcium-rich fens, drainage channels and some acid wet grasslands</u>)</p> <p>CARICETALIA NIGRAE (<u>Small-sedge communities of poor fen</u>) Small-sedge poor-fen vegetation of acid, oligotrophic flushes and soligenous bogs on peat's or peaty mineral soils. Four associations in Ireland: Carici curtae-Agrostidetum caninae, Caricetum magellanicae, Sphagneto-Juncetum effusi, Drepanoclado exannulati-Caricetum aquatilis</p> <p>CARICETALIA DAVALLIANAE (<u>Small-sedge communities of rich fen</u>) Vegetation of rich fens on calcareous, alkaline peats. Four associations in Ireland: Carici nigrae-Juncetum articulati, Campylio-Caricetum dioicae, Schoenetum nigricantis, Juncetum subnodulosi</p> <p>SCHUCHZERIETALIA PALUSTRIS (<u>Small-sedge vegetation of quaking transition fens between poor and rich</u>) Sphagno Caricion lasiocarpae Two associations in Ireland: Sphagneto-Caricetum lasiocarpae, Calliergo-Caricetum diandrae</p> |
| <p>PHRAGMITIO - MAGNOCARICETEA (<u>Tall reed and herb vegetation within fens</u>)</p> <p>PHRAGMITALIA (<u>Vegetation of tall emergent aquatics</u>)</p> <p>MAGNOCARICETALIA (<u>Vegetation dominated by large sedges often in zones around open water behind reed swamps</u>)</p> |
| <p>FRANGULETEA (<u>Shrub-willow vegetation</u>)</p> <p>SALICETALIA AURITAE (<u>Vegetation of hygrophilic shrubs 1-5 m high, usually found on margins of lakes or slow-flowing streams on peat or mineral soil</u>)</p> |
| <p>ALNETEA GLUTINOSAE (<u>Fen woodland dominated by Alnus glutinosa, climax vegetation for many fens</u>)</p> <p>ALNETALIA GLUTINOSAE</p> |
| <p>MONTIO - CARDAMINETEA (<u>Vegetation of cold springs, commonly dominated by bryophytes</u>)</p> <p>MONTIO - CARDAMINETALIA Cardamino-Montion (<u>Vegetation of base-poor, non-calcareous springs</u>)</p> <p>Cratoneurion (<u>Vegetation of calcareous springs</u>)</p> |

Source: White & Doyle 1982; Ó Críodáin & Doyle, 1994; O'Connell, Ryan and Macgowran 1984; Kelly & Iremonger 1997. (Phytosociological classification scheme: Class - Caps/bold; Order - Caps /plain; Alliance - lowercase/ bold; Association - lowercase/plain)

A more detailed account of Irish fen types and their plant communities is provided by White & Doyle (1982); Ó Críodáin 1988; Crushell (2000) and Wheeler (1984) inter alia.

Only outline summaries of the main vegetation types are provided here.

SCHEUCHZERIO-CARICETEA (synonym PARVOCARICETEA)

Small sedge vegetation of swamps, rheotrophic mires, calcium-rich fens, drainage channels and some acid wet grasslands.

Character species for Ireland: *Carex demissa*, *C. nigra*, *Epilobium palustre*, *Galium palustre*, *Hydrocotyle vulgaris*, *Pedicularis palustris*, *Potentilla palustris*, *Ranunculus flammula*

CARICETALIA NIGRAE

Small sedge communities of poor fen and bog flushes. Vegetation of swamps, rheotrophic mires, some acid grasslands and drainage channels.

Character species: *Carex echinata*, *Viola palustris*

Differential species of order and alliance: *Sphagnum palustre*

Carici curtae-Agrostidetum caninae

Poor fen located in slightly enriched areas on acid peat (water pH range 4.0-5.6), on the fringes of bog streams, pools and lakes and in bog hollows in cutover.

Character species: *Agrostis canina*, *Carex curta*, *C. echinata*

(also *Carex nigra*, *C. rostrata*, *Eriophorum angustifolium*, *Holcus lanatus*, *Juncus bulbosus*, *Molinia caerulea* and *Potentilla erecta*)

Caricetum magellanicae

Poor fen located in impoverished wet bog hollows (water pH range 3.8-5.0).

Character species: *Carex magellanica*

(also *Carex rostrata*, *Eriophorum angustifolium*, *Vaccinium oxycoccus*, *Sphagnum papillosum*, *S. palustre*, *Polytrichum commune*)

Sphagneto-Juncetum effusi

Fen vegetation on drainage channels or flushes in acid bogs (water pH range 3.1-6.2). Striking morphology with vegetation reaching 1 m in height, with pronounced *Sphagnum* carpet.

Character species: *Juncus effusus*, *Sphagnum recurvum*

Differential species: *Galium saxatile*, *Polytrichum commune*

Drepanoclado-Caricetum aquatilis

Species rich vegetation in which *Carex aquatilis* is dominant. Occurs in river and lake margin vegetation in north of country.

Character species: *Carex aquatilis*

CARICETALIA DAVALLIANAE

Small sedge rich fen communities. Vegetation of mineral-rich fens and base-rich fens on calcareous, alkaline peats.

Character species of order and alliance: *Aneura pinguis*, *Carex lepidocarpa*, *Dactylorhiza incarnata*, *Parnassia palustris*, *Pinguicula vulgaris*, *Campylium stellatum*, *Drepanocladus revolvens*, *Fissidens adianthoides*, *Scorpidium scorpioides*

Carici nigrae-Juncetum articulati

Waterlogged habitats in low lying areas in hollows along mesotrophic lake shores, deep drainage channels in blanket bog areas and neglected drainage channels in rough grassland. Also lakes in machair and wet dune hollows (water pH range 5.5-8.3).

Character species: *Carex nigra*, *Hydrocotyle vulgaris*, *Juncus articulatus*, *Ranunculus flammula*

(with other commonly occurring *Galium palustre*, *Mentha aquatica*, *Calliergon cuspidatum*)

Differential species against the Plantaginetea majoris: *Caltha palustris*, *Carex rostrata*, *Eleocharis palustris*, *Equisetum fluviatile*, *Lythrum salicaria*, *Myosotis laxa*, *Menyanthes trifoliata*, *Phragmites australis*

Campylio-Caricetum dioicae

Vegetation typical of grazed calcareous flushes, sometimes surrounded by relatively calcifuge vegetation (water pH range 4.6-7.5).

Character species: *Carex demissa*, *C. dioica*, *C. hostiana*, *Eleocharis quinqueflora*

(with other commonly occurring *Carex nigra*, *C. echinata*, *C. panicea*, *C. pulicaris*, *Anagallis tenella*, *Eleocharis multicaulis*, *Hydrocotyle vulgaris*, *Juncus bulbosus*, *Ranunculus flammula* and *Succisa pratensis* with some acid indicators such as *Eriophorum angustifolium*, *Molinia caerulea* and *Potentilla erecta*)

Differential species within the Caricion davallianae: *Carex echinata*, *Juncus bulbosus*

Schoenetum nigricantis

Schoenus nigricans dominated base-rich fens and in well established flushes that are ungrazed, where tussock formation is typical (water pH range 5.5-8.1).

Character species: *Schoenus nigricans*

Juncetum subnodulosi

Juncus subnodulosus dominated calcium-rich fen vegetation (water pH range 5.6-8.5), typical of the contact zone between Cladietum marisci and the Schoenetum nigricantis.

Character species: *Juncus subnodulosus*

(with other commonly occurring *Carex lepidocarpa*, *C. panicea*, *Galium palustre*, *Mentha aquatica*, *Molinia caerulea* and *Ranunculus flammula*)

SCHEUCHZERIA ET ALIA PALUSTRIS

Sphagno Caricion lasiocarpae

Vegetation of wet hollows on bogs. Small-sedge vegetation of quaking transition fens between poor and rich.

Character species: *Carex limosa*, *Rhynchospora alba*, *Menyanthes trifoliata*, *Sphagnum cuspidatum*, *Sphagnum apiculatum*, *Sphagnum subsecundum*, *Cladopodiella fluitans*

Sphagneto-Caricetum lasiocarpae

Floating quaking-bog vegetation, usually confined to the waterlogged marginal areas around areas of acid peat or fens (water pH range 3.8-5.8). *Carex lasiocarpa* prominent species, along with *Carex limosa*, *Hydrocotyle vulgaris*, *Menyanthes trifoliata*, *Molinia caerulea*, *Myrica gale*, *Potentilla palustris*, and *Ranunculus flammula*.

Character species: *Carex lasiocarpa*

Differential species: *Myrica gale*, *Sphagnum auriculatum*

Calliergo gigantei-Caricetum diandrae

Floating or quaking mire vegetation, calcicole in character (water pH range 5.0-7.5), rich in pleurocarpus mosses, found in seepage areas around fens.

Character species: *Carex diandra*, *Bryum pseudotriquetrum*, *Calliergon giganteum*

Differential species within the alliance: *Carex lasiocarpa*

(with other commonly occurring *Carex diandra*, *C. rostrata*, *C. lasiocarpa*, *C. nigra*, *Scorpidium scorpioides*, *Galium palustre*, *Hydrocotyle vulgaris*, *Menyanthes trifoliata*, *Potentilla palustris*, *Calliergon cuspidatum*)

PHRAGMITIO - MAGNOCARICETEA

Tall clonal reed and sedge and herb vegetation. Species poor or mono dominant stands with pronounced mosaic structure. Swampy areas near lakes, rivers, streams and within fens

PHRAGMITALIA

Vegetation of tall emergent aquatics, mostly poor in species, often mono dominant, stagnant to slightly running water 0.2 to 3 m deep.

Character species: *Phragmites australis*, *Typha latifolia*, *Iris pseudacorus*, *Sparganium erectum*

MAGNOCARICETALIA

Vegetation dominated by large sedges, eutrophic to mesotrophic water, often in zones around open water behind reed swamps of the alliance Phragmition.

Character species: *Carex vesicaria*, *C. paniculata*, *C. acuta*, *C. aquatilis*, *Galium palustre*, *Poa palustris*, *Cladium mariscus*

FRANGULETEA

Shrub-willow vegetation growing on minerotrophic peat or mineral soil where there is a constant, high water table. Water may be oligotrophic to eutrophic.

SALICETALIA AURITAE

Vegetation of hygrophilic shrubs 1-5 m high, usually found on margins of lakes or slow-flowing streams on peat or mineral soil, poor to moderately rich, continually high water table.

Character species: *Salix aurita*, *Salix atrocinerea*, *Frangula alnus*, *Myrica gale*

ALNETEA GLUTINOSAE

Fen woodland dominated by *Alnus glutinosa*, climax vegetation for many fens.

ALNETALIA GLUTINOSAE

Character species: *Alnus glutinosa*, *Thelypteris palustris*

MONTIO - CARDAMINETEA

Vegetation of springs fed by water of more or less even temperature, commonly dominated by bryophytes.

MONTIO - CARDAMINETALIA

Diagnostic species of class and order: *Cardamine amara*, *Saxifraga stellaris*, *Epilobium alsinifolium*, *Brachythecium rivulare*

Cardamino - Montion

Spring vegetation fed by base-poor waters often in western and mountain areas

Diagnostic species: *Stellaria alsina*, *Epilobium obscurum*, *Chiloscyphus polyanthus* var. *rivularis*

Differential from Cratoneurion: *Pellia epiphylla*

(with other species occurring *Philonotis fontana*, *Saxifraga stellaris*, *Montia fontana* ssp. *rivularis*, *Montia fontana* ssp. *fontana*, *Dicranella palustris*, *Scapania uliginosa*, *Chrysosplenium oppositifolium*, *Mnium punctatum*)

Cratoneurion

Vegetation of calcareous springs fed by mineral rich water

Character species: *Cratoneuron filicinum*, *Philonotis calcarea*, *Saxifraga aizoides*

Differential from Cardamino-Montion: *Equisetum telmateia*

(with other species occurring *Saxifraga hirculus*, *Cardamine pratensis*, *Holcus lanatus*, *Calliargon cuspidatum*, *Sagina nodosa*, *Plagiomnium ellipticum*, *Galium palustre*, *Potamogeton polygonifolius*, *Juncus bulbosus*, *Aneura pinguis*, *Caltha palustris* and the rarer species: *Homalothecium nitens*, *Drepanocladus vernicosus*, *Drepanocladus exannulatus* var. *rotae*, *Sphagnum teres*)

4.7 Fen Classification Scheme based on underlying peat soils

In the "Peatlands of Ireland" report (which accompanied the new Peatland Map of Ireland) Hammond (1979) classified peatland types in Ireland based on peat soil type.

He defined peat soils as "Organic soil material that are saturated with water for prolonged periods, or are artificially drained, and have 30% or more organic matter if the mineral fraction is 50% or more clay, or 20% or more organic matter if the mineral fraction has no clay, or proportional intermediate organic matter contents if the clay fraction is intermediate".

In addition in relation to peat depth he defined peatlands as "For land to be classed as peatland the depth of organic soil material, excluding the thickness of plant layer, must be 45 cm on undrained land and 30 cm on drained land".

He further recognised a "natural" and man-modified peatland type, which he defined as "where the surface of the peatland has been physically disturbed and the natural vegetation altered, by drainage (for agriculture, forestry or fuel production) and grazing".

In relation to fen mire soils he made no subdivision in the fen peats (natural or man-modified) since "(a) many fens are contiguous with raised bogs, and (b) in most cases they (fens) have been drained and are now under permanent pasture".

The characteristic vegetation species associated with fens in its natural state are *Schoenus nigricans*, *Cladium mariscus* and *Phragmites australis*.

5. Former Extent of Fens in Ireland

5.1 Peatlands of Ireland fen extent

In the "Peatlands of Ireland" report (which accompanied the new Peatland Map of Ireland) Hammond (1979) classified peatland types in Ireland based on peat soil type as mentioned earlier.

This survey incorporated a range of data sources, published and unpublished, to compile information on the extent of fen peat soils in Ireland (National Soil Survey programme of An Foras Taluntais operated from 1968; Aerial Photograph series 1973/74 undertaken by the Geological Survey of Ireland; 1920 Geological Survey Peat Map; inter alia) and represents the first major project to quantify the area of the different peat types, including fens, in Ireland on a county by county basis.

A major drawback of the Hammond study in relation to the present study of intact fens is that Hammond defined and recorded only a man-modified fen category in his survey.

In his word "Undisturbed fens are rare and can only be found in a few counties in Ireland. Owing to their small size their representation on the map is not possible, even their continued existence as natural entities is under threat from agriculture and urban pressures".

It would also appear from this report that only fens with a deep peat layer (greater than 30 cm) were included. Therefore in relation to the 6 fen types being investigated by the NPWS Fen Study and the range of habitat types in which these fens occur, the report of Hammond relates to only the most extensive fen areas generally found in association with raised bog areas.

It is therefore likely that the total area of fen in Ireland recognised in Hammond is an under representation of the total extent of fens in Ireland at that time.

This argument is further strengthened by the fact that Hammond (1979) records no fens in Counties Carlow, Cork, Donegal, Dublin, Monaghan or Wicklow, counties which subsequent reports show contain in excess of 3,000 ha of fen (see Crushell 2000, IPCC peatland conservation plans, below). Also the area of fen in Counties Mayo and Galway (469 ha and 10,012 ha respectively) seem rather low for counties with such an extensive blanket bog cover, suggesting that poor fens were not recognised in the Hammond study, and were included within his blanket bog figure for these counties.

Nonetheless Hammond recognised some 92,510 ha of man-modified fen in Ireland, a figure which still represents a minimum "best estimate" of the total extent of fen soils and fen habitats in Ireland.

Examples of this fen peat type occur in most Irish counties (see Table 5.1). The greatest concentration of sites occurred in the midlands and westwards into counties Galway, Mayo and Clare.

The Soil Division of Teagasc subsequently digitised the original Hammond 1979 fen data and maps. This digitised data set indicates that 411 polygons exist which contain fen peat in the Republic of Ireland with a total area of 96,646 ha, some 4,136 ha more than that reported originally by Hammond in his 1979 paper. At present no explanation for the discrepancy can be provided by Teagasc, and the original figure of 92,510 ha for fen peat in Ireland will be used when referring to this source.

Table 5.1: The original area (ha) of fen by County in Ireland after Hammond 1979

| County | Area (ha) |
|-----------|-----------|
| Carlow | 7,883 |
| Cavan | 81 |
| Clare | 0 |
| Cork | 0 |
| Donegal | 0 |
| Dublin | 0 |
| Galway | 10,012 |
| Kerry | 5,844 |
| Kildare | 316 |
| Kilkenny | 4,654 |
| Laois | 1,232 |
| Leitrim | 81 |
| Limerick | 16,030 |
| Longford | 5,140 |
| Louth | 352 |
| Mayo | 3,901 |
| Meath | 0 |
| Monaghan | 469 |
| Offaly | 13,901 |
| Roscommon | 4,828 |
| Sligo | 1,279 |
| Tipperary | 4,298 |
| Waterford | 11,026 |
| Westmeath | 0 |
| Wexford | 566 |
| Wicklow | 615 |
| Total | 92,508 |

Source: after Hammond 1979 & Foss, P.J., O'Connell C.A. & Crushell P. (eds.) 2001

5.2 An Foras Forbartha habitat surveys

The first group to attempt to compile a list of intact fens of conservation value in Ireland, as part of a larger examination of heritage sites in Ireland was An Foras Forbartha (AFF) (Anonymous 1981).

Their survey commenced in 1968 when they started compilation of a National Heritage Inventory which included both man-made and natural structures, and finished in 1974. Initially the information collected was published in a series of reports concerning Areas of Scientific Interest (ASIs) in each county. This data was subsequently collated in a Areas of Scientific Interest in Ireland report in 1981, which AFF hoped would act as a baseline for further studies.

Their report lists a total of 99 fen sites with a total area of 24,472 ha in Ireland (see Table 5.2). No subdivision of the "fen" category is made in the report. Although a significant number of geological and geomorphological sites are listed none refer to sites with tufa formation.

A shortcoming of this AFF report and the associated county reports, from the perspective of this NPWS Fen Study, is that although a list of fens was produced for each county, the area of fen that can be extrapolated from the report is exaggerated, as certain areas listed (e.g. Lough Corrib in Galway has a stated area of 8,500 ha - but no clear indication how much of this is fen habitat) making it difficult to calculate a meaningful value for the total area of fen in Ireland.

Table 5.2: The number and area (ha) classified as fens by county from An Foras Forbartha 1981

| County | Area (ha) | No. of sites |
|-----------|-----------|--------------|
| Carlow | 38 | 1 |
| Cavan | 34 | 1 |
| Clare | 892 | 9 |
| Cork | 553 | 2 |
| Donegal | 65 | 1 |
| Dublin | 9 | 1 |
| Galway | 8,505 | 2 |
| Kerry | 412 | 2 |
| Kildare | 180 | 3 |
| Kilkenny | 347 | 4 |
| Laois | 702 | 4 |
| Leitrim | 100 | 1 |
| Limerick | 163 | 6 |
| Longford | 103 | 2 |
| Louth | 126 | 3 |
| Mayo | 2,075 | 6 |
| Meath | 363 | 6 |
| Monaghan | 96 | 5 |
| Offaly | 349 | 4 |
| Roscommon | 559 | 7 |
| Sligo | 7 | 1 |
| Tipperary | 665 | 2 |
| Waterford | 125 | 5 |
| Westmeath | 4,427 | 11 |
| Wexford | 258 | 2 |
| Wicklow | 3,319 | 8 |
| Total | 24,472 | 99 |

Source: after Anonymous 1981. Note that area data refers to total site extent and is not necessarily the extent of fen vegetation present.

5.3 Irish Peatland Conservation Council fen extent

The work of the Irish Peatland Conservation Council (formerly the National Peatland Conservation Committee) since 1982 has been instrumental in expanding and refining our knowledge of the list of fens of conservation value in Ireland.

This non-governmental group has published a series of peatland action and conservation plans since the early 1980's which have consistently listed all known intact fen sites (in a single "Fen" category) of conservation value in Ireland (Anonymous 1986; Anonymous 1989; Anonymous 1992; Foss & O'Connell 1996; Foss, O'Connell and Crushell 2001). These lists of sites were compiled from published information sources (e.g. An Foras Forbartha ASI report; NPWS NHA site lists; private sources and their own site surveys).

Furthermore the IPCC added to the list of known fen sites over the same period (see Table 5.3). The group also called for a national fen survey to be undertaken by the Government as a matter of urgency, especially in light of the extent of fen habitat loss being experienced.

In addition in 1999 the IPCC undertook an Irish Fen Inventory study (Crushell 2000), in the absence of any Government based national fen survey. The IPCC called on assistance of fen experts and contacts nationally to provide data on existing and as yet undesignated sites that might nevertheless have a conservation value. The overall aims of the study were to:

- * create a reliable list of intact fen sites that occurred in Ireland including those without (as yet) any formal conservation designation;
- * formulate a more detailed classification system for fens in Ireland;
- * determine (more accurately) the area of fen in each conservation fen site recognised in Ireland;
- * list the proportion of the total fen habitat that had been given some form of statutory protection.

The results of the study also fed into the EU Habitats Directive Natura 2000 process undertaken jointly by the non-governmental organisations (Crushell 2002; Dwyer 2000) in Ireland to ensure that where key habitats were underrepresented in the national list a greater number of (fen) sites would be considered for designated as Special Areas of Conservation.

During the fen survey Crushell (2000) re-classified fens within the IPCC sites database into six specific fen categories, namely: open water transition fen; floodplain fen; basin fen; valley fen; flush fen and calcareous spring (see Chapter 3 Classification Systems in this report for a definition of these fen types) and undertook a reappraisal of the area of fen habitat within sites that also included significant non-fen areas (e.g. open water area in the case of lake sites).

One result of the IPCC's Irish Fen Inventory survey was that although the number of sites with a known or possible conservation value increased from the previously published IPCC fen sites list (Foss & O'Connell 1996) from 245 sites to 342 sites, the area of the fen habitat (as opposed to areas of open water and other habitat previously included in the total area of fen calculated) fell from 54,027 ha to just 19,621 ha. This was an indication that fens were not as extensive in Ireland as previously thought (Crushell 2000; Table 5.4).

In IPCC's most recent analysis (Foss, O'Connell and Crushell 2001) the area of fen present in each county amounted to 19,660 ha in a total of 367 sites (see Table 5.5), slightly more than the area and number of sites reported in Crushell (2000).

Table 5.3: The number and area of conservation worthy fen in the Republic of Ireland listed in successive NPCC and IPCC action plans (Source: NPCC Site list 1982, Crushell 2000 & IPCC Conservation Plans 1986 to 2001 inter alia.)

| Source | Area (ha) | No. of sites |
|---|-----------|--------------|
| National Peatland Conservation Committee 1982 | 1,625 | 6 |
| Anonymous 1986 IPCC Action Plan 1987-1989 | 1,908 | 7 |
| Anonymous 1989 Irish Peatland Conservation Programme 1989-92 IPCC Action Plan | 1,943 | 10 |
| Anonymous 1992 IPCC Policy & Action Plan 1992-1997 | 48,240 | 122 |
| Foss & O'Connell 1996 IPCC Conservation Plan 2000 | 54,027 | 221 |
| Crushell 2000 IPCC Irish Fen Inventory | 19,621 | 342 |
| Foss, O'Connell and Crushell 2001 IPCC Bogs & Fens Conservation Plan | 19,660 | 367 |

One factor that may indicate that the area of fen obtained from the IPCC surveys is still only a crude estimate and probably an over estimate, is the fact that reed beds and large sedge vegetation were defined and included within their fen category for the purpose of area calculations.

Also, poor fen vegetation found in blanket bogs was not included in IPCC's fen inventory area calculation, further limiting the value of this data.

Table 5.4: The area (ha) and number of fens in each fen category recorded in the IPCC Irish Fen Inventory (from Foss, O'Connell & Crushell 2001 after Crushell 2000)

| Fen Type | Area (ha) | No. sites |
|-----------------------|-----------|-----------|
| Open Water Transition | 13,619 | 209 |
| Floodplain | 2,315 | 34 |
| Basin | 1,352 | 34 |
| Valley | 1,171 | 26 |
| Flush | 543 | 34 |
| Calcareous Spring | 638 | 21 |
| Total | 19,638 | 358 |

Table 5.5: Conservation worthy fen area (ha) and number of sites recognised by IPCC in 2001 in each Irish County

| County | Conservation Area (ha) | Number of Sites |
|--------------|------------------------|-----------------|
| Carlow | 806 | 16 |
| Cavan | 340 | 9 |
| Clare | 90 | 3 |
| Cork | 893 | 13 |
| Donegal | 1,318 | 14 |
| Dublin | 96 | 3 |
| Galway | 2,419 | 34 |
| Kerry | 339 | 8 |
| Kildare | 554 | 11 |
| Kilkenny | 386 | 11 |
| Laois | 843 | 8 |
| Leitrim | 160 | 8 |
| Limerick | 399 | 13 |
| Longford | 572 | 5 |
| Louth | 437 | 19 |
| Mayo | 223 | 10 |
| Meath | 214 | 13 |
| Monaghan | 2,460 | 38 |
| Offaly | 954 | 14 |
| Roscommon | 1,650 | 21 |
| Sligo | 475 | 26 |
| Tipperary | 1,571 | 16 |
| Waterford | 1,161 | 20 |
| Westmeath | 543 | 12 |
| Wexford | 406 | 6 |
| Wicklow | 351 | 16 |
| Total | 19,660 | 367 |

Source: Foss, P.J., O'Connell C.A. & Crushell P. (eds.) 2001

5.4 The NPWS fen conservation process and fen extent

5.4.1 Natural Heritage Area Process

The basic designation for wildlife conservation sites in Ireland is the Natural Heritage Area (NHA). In 1995, the NPWS (then called Dúchas) proposed the designation of over 1,100 NHAs (pNHA). It was not until December 2000, however, that powers were introduced for the statutory process of their designation and protection. Many of these pNHAs have overlapping designations of SAC and/or SPA.

The process of formal designation of NHAs commenced in December 2002. It is hoped that most landowners will appreciate the need for protection of wildlife areas and will be satisfied with the incentives and compensation available. However, it will be possible for the landowner to object on scientific grounds to a proposed designation if s/he wishes, before the designation is confirmed. After allowing time for landowners to consider and if necessary appeal the proposed areas, the Minister will formally designate these sites.

Prior to statutory designation, proposed NHAs are subject to limited protection, in the form of:

- Rural Environment Protection Scheme (REPS) plans which require conservation of NHAs and operate for a period of 5 years
- Ineligibility of NHA lands for certain grants, in particular for Forestry grants
- Recognition of ecological value of NHAs by Planning and Licencing Authorities.

Under the Wildlife (Amendment) Act, 2000 NHAs will be legally protected from damage from the date they are formally proposed.

5.4.2 Special Areas of Conservation (SAC) Process

SACs are prime wildlife conservation areas in the country, considered to be important on a European as well as Irish level.

The EU Habitats Directive (92/43/EEC) was transposed into Irish law in the European Union (Natural Habitats) Regulations, 1997. These Regulations have since been amended twice with Statutory Instruments SI 233/1998 and SI 378/2005.

The Habitats Directive lists (in Annex 1) certain habitats that must be protected within Special Areas of Conservation (SACs). Irish habitats included within Annex 1 of the Directive include four types of fens, raised bogs, blanket bogs, turloughs, heaths, lakes, and rivers inter alia.

There is also a list (Annex 2) of species for which SAC must be designated in Ireland.

The Directive seeks to establish "Natura 2000", a network of protected areas throughout the European Community. It is the responsibility of each member state to designate Special Areas of Conservation (SACs) to protect habitats and species, which, together with the Special Protection Areas (SPAs) designated under the EU Birds Directive(79/409/EEC), form Natura 2000.

The Habitats Directive was transposed into national legislation by the European Union (Natural Habitats) Regulations, S.I. 94/1997 and amendments SI 233/1998 & SI 378/2005 which include the following points:

- The Minister must propose a list of SACs for designation.
- Landowners should be notified of designation, and the Minister must make all reasonable efforts to do so.
- Landowners may appeal the designation of lands on scientific grounds.
- Landowners will be compensated for actual loss of income arising from designation.
- The Minister must prepare lists of "Notifiable Actions" for different habitats, which

should be sent to known landowners and users. Any actions in the lists can be carried out only with prior agreement of the Minister.

- A person who illegally damages a site may be prosecuted or required to repair damage.
- The Minister must transmit information on SACs to the European Commission for consideration.
- Following agreement by the Commission, the Minister will formally designate the sites as SACs.
- Sites are legally protected once they are publicly advertised.

5.4.3 Fen Extent

As part of the SAC designation process an internal document prepared by Ó Críodáin in 1995 estimated the national extent of Calcareous fens with *Cladium mariscus* at 2,500 ha; Petrifying Springs with Tufa at 0.5 ha; Transition mires and Quaking bogs at 6,000 ha and Alkaline fens at 12,000 ha (Ó Críodáin pers. comm.).

This gave a total estimated area figure for fens in Ireland of some 20,500 ha. No data was estimated for poor fens or non-calcareous springs.

In 2003 Doyle & Ó Críodáin provided additional data from NPWS which indicated the number of sites proposed as candidate SAC's for fen habitats and the area of fen protected within these sites which amounted to 3,620 ha in total within 35 sites (see Table 5.6) .

Table 5.6: The number fen sites and area of fen sites in Ireland with statutory protection

| Fen type | Number of sites | Area hectares |
|---|-----------------|---------------|
| Alkaline fen | 22 | 2,220 |
| Calcareous fen with <i>Cladium mariscus</i> | 5 | 600 |
| Transitional fen | 8 | 800 |

Source: Doyle & Ó Críodáin (2003) with data supplied by Dúchas

The most recent information available within NPWS (based on information published on the official NPWS web site) indicates that the number of sites proposed for designation as SAC under one of the four Annex 1 fen habitat types has increased from the 2003 figure of 35 sites to a 2006 figure of 92 sites (see Table 5.7). No area data for the amount of fen habitat protected was supplied.

Table 5.7: The number of fen sites in Ireland presently protected as Special Areas of Conservation by the National Parks and Wildlife Service 2006

| Fen type | Number of sites listed |
|---|------------------------|
| 7140 Transition mires and quaking bogs | 17 |
| 7210 *Calcareous fens with <i>Cladium mariscus</i> and species of the Caricion <i>davallianae</i> | 17 |
| 7220 * Petrifying springs with tufa formation (<i>Cratoneurion</i>) | 20 |
| 7230 Alkaline fens | 38 |
| Total | 92 |

Source: NPWS web site, download data dated 14.3.2006

The NPWS pNHA database, created to hold data on Natural Heritage Areas, indicated that in 2006, 478 sites were classified as containing Fens & Flushes vegetation. However no further hierarchical division of this classification category was made.

In terms of the area of Fens & Flushes recorded on these sites no data was ever published from the database. Although an estimated value on the extent of the Fens & Flushes habitat, was calculated on the majority of sites, as part of the 1990's NHA designation process (based on the scale of 1 to 4 referred to earlier) - data for this was computerised for only one third of the sites (Lockhart pers. comm.), making total extent calculations impossible. For the non-computerised sites data, information on the extent of Fen & Flushes vegetation on sites, was only available on paper based NHA site file.

Most recently (2005 and 2006), the habitats classification system used within the NPWS Sites database has been revised in line with the habitats classification scheme proposed by Fossitt (2000). This involved a habitat re-classification or reassignment on all sites from the scheme in Lockhart (1993) to that in Fossitt (2000) (Lockhart pers. comm.) and is on-going.

From a preliminary version of this new NPWS Sites database compiled in July 2006, with habitats classified according to Fossitt (2000), a total of 479 sites with fen vegetation corresponding to one of the 6 categories being recorded in this NPWS Fen Study were obtained (Cladium fen and Alkaline fens are treated as one under the Fossitt scheme). No information on the extent of the various fen types on sites is currently available in this new NPWS Sites database.

6. Compilation of the NPWS Fen Study Database

6.1 Background

This NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland was undertaken over an 8 month period which started in June 2006. The study did not involve any field survey of sites, with the exception of one two day visit to see a limited number of sites in County Monaghan at the invitation of the County Heritage Officer.

Information on known and potential Irish fens of conservation value; as well as key areas where fens might be likely to occur was abstracted from a variety of published and other information sources, and through personal communication with interested individuals and groups.

One of the main challenge of this project was to abstract a list of sites containing one of the 6 fen types being investigated (see below) and obtain area estimates for the different fen types present on the sites in Ireland.

6.2 Materials & Methods

The data collection period for the compilation of sites held within the NPWS Fen Study database was undertaken from the 8 June 2006 to 17 November 2006.

6.2.1 Background site research

Background research for the Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland involved a detailed literature review and examination of scientific and survey reports held within NPWS, and external sources.

The list of publications, reports and surveys consulted in the compilation of the list of sites with fens in Ireland is provided in Appendix 1.

6.2.2 Identification of sites with fen habitats

The NPWS Fen Study database also contains information held by the NPWS (and IPCC) in a series of databases holding information on undesignated, NHA and SAC sites. The list of database sources consulted in the compilation of the site list is provided in Appendix 4.

Within these databases fens have been identified and assigned to a particular fen category using a variety of classification schemes, including the Annex 1 Habitats Directive system; the CORINE wetland classification system; together with other classification systems used in relation to specific habitat studies by the NPWS and IPCC (e.g. NHA survey, fens & flushes, system of Crushell 2000) and raised and blanket bog surveys.

A list of sites containing various "fen" categories identified by these research groups within NPWS, was produced from the various databases that existed to compile a comprehensive list of all sites (and site complexes) that contain fen vegetation. For the sake of completeness sites with a series of related wetland habitat categories, that might include fen, were also examined from the more recent data sets (i.e. reed beds, swamps and marshes).

The full list of data sets used to compile the NPWS Fen Study data set is provided in Appendix 4.

The sequence in which data sets and reports were examined and new fen sites were added to the Fen Study database (where applicable) was as follows:

1. NPWS cSAC database of designated sites for Annex 1 Fen Habitats
 2. Conaghan Blanket Bog database site list
 3. IPCC new undesignated non-NHA/SAC fen database site list
 4. Derwin Blanket Bog database site list
 5. Ecoserve springs sites
 6. NPWS 2006 database fen sites list (based on Fossitt fen classification; and Annex 1)
 7. NPWS 2006 database sites not presently designated for fen (i.e. reed bed and marsh list)
 8. Undesignated fen sites reported to NPWS and held by N. Lockhart
 8. Fergus river report sites with fen habitats (Curtis & McGough 1981)
 9. Old NPWS database with CORINE listed fen sites
 10. Old NPWS database with Fens & Flushes listed sites
 11. Crushell 2002 NGO SAC Shadow Report listed sites
12. External undesignated fen sites submitted to the study were added to the database on an ongoing basis.

6.2.3 Site Complexes - Main site and sub site(s) records

Once a site had been selected for inclusion into the NPWS Fen Study database, based on the presence of one of the 6 fen types being recorded in this study, an individual site record was created. Basic site data (county, grid reference etc.) and data in relation to the occurrence and extent of one of the 6 fen types was recorded in relation to each site record.

Where more than one individual site occurred within a larger NHA or SAC complex, a Site Complex main site record was created, and the individual site record(s) were re-assigned to a Site Complex sub unit record within the main site complex.

6.2.4 Fen habitat type classification

Once the list of sites had been compiled the various fen classification schemes used by previous workers in their surveys and analyses were examined and a re-classification of fen habitat types was undertaken to reflect the classification scheme proposed in this NPWS Fen study.

In certain cases this classification involved examination of written accounts and survey information held for these sites to decide on the appropriate NPWS Fen Study category to apply.

Where the fen habitat could be assigned with confidence the fen type was listed in the "confirmed fen type present" category, where there was doubt about the fen type that was present on a site a best guesstimate fen type was selected and listed in the "possible fen type present" category.

Following the compilation of the draft site list for fens, the list was screened and duplicate sites were identified, data held within duplicates was consolidated and the duplicate record was removed.

6.2.5 Classification system used in the NPWS Fen study

As the results of this NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland were to feed into the Natura 2000 reporting process, it was decided to classify fens within the scope of this study into one of the following 6 categories, the first 4 of which are EU Habitats Directive Annex 1 fen habitat types:

- ◊ 7140 Transition mires and quaking bogs (Fossitt category PF3)

- ◊ 7210 *Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (Fossitt category PF1)
- ◊ 7220 * Petrifying springs with tufa formation (*Cratoneurion*) (Fossitt category FP1)
- ◊ 7230 Alkaline fens (Fossitt category PF1)
- ◊ Poor Fens (*Caricion curto-nigrae*) (Fossitt category PF2)
- ◊ Non-Calcareous springs (Cardamino - Montion) (Fossitt category PF2)

Poor fens and Non-Calcareous springs were included to ensure completeness of the information gathering exercise for fens in Ireland, as these two fen habitat types are not specifically included under the other four EU Habitats Directive Annex 1 fen categories.

The current NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland is therefore firstly a study based on floristic classification criteria.

See Appendix 7 for a list of the 6 fen types being recorded in the present NPWS Fen Study. This appendix provides a brief description of the main habitats within which these fen types can occur together with site examples of each.

For further information on the detailed floristic makeup of these fen types see Chapter 4 in this report, in particular the section on the phytosociological classification of fens.

Table 6.1 below summarised the various classification schemes that have been applied to Irish fens to date and shows how these relate to one another and the fen classification scheme being adopted within the NPWS Fen Study 2007.

Table 6.1: NPWS Fen Study Classification scheme summary table. Summary table showing fen classification used in the present study and how this relates to other schemes for the classification of fens.

| NPWS Fen Study Classification Scheme | EU Habitats Directive Annex 1 Habitats | CORINE Habitat Scheme | Fossitt Classification Scheme | Phytosociological Classification | Key Species | Habitat Examples |
|--------------------------------------|---|--|-------------------------------------|--|---|--|
| Transition mire 7140 | 7140 Transition mires and quaking bogs | 545 Transition mires | PF3 Transition mire and quaking bog | Scheuchzerietalia palustris to Caricetalia nigrae | Carex limosa, C. diandra, C. lasiocarpa, C. viridula, Eriophorum angustifolium, E. gracile, Agrostis stolonifera, Molinia caerulea, Menyanthes trifoliata, Potentilla palustris, Pedicularis palustris, Sphagnum spp., Calliergon spp., Scorpidium spp. | Quaking areas on blanket and raised bogs; bog laggs; secondary fen areas of cutover bog; |
| Cladium Fen 7210 | 7210 *Calcareous fens with Cladium mariscus and species of the Caricion davallianae | 533 Fen Sedge Beds; 5331 Fen Cladium Beds | PF1 Rich fen and flush | Magnocaricion - Cladietum marisci to Caricetalia davallianae | Cladium mariscus and species of Alkaline fens (see below) | Fen beds of the emergent-plant zones of lakes; Cladium stands in blanket bog flushes and fens; |
| Petrifying Spring with Tufa 7220 | 7220 * Petrifying springs with tufa formation (Cratoneurion) | 5412 Hard Water Springs Cratoneurion | FP1 Calcareous Springs | Cratoneurion | Saxifraga aizoides, Carex dioica, C. pulicaris, C. flacca, C. nigra, Pinguicula vulgaris, Equisetum palustre | Calcium rich spring areas in fens, woodland, sea cliffs, esker ridges, limestone areas, Mayo blanket bogs |
| Alkaline fen 7230 | 7230 Alkaline fens | 542 Rich Fens Caricion davallianae; 5421 Black bog rush fens; 5422 Fens not Schoenus dominated | PF1 Rich fens and flushes | Caricetalia davallianae | Schoenus nigricans, Homalothecium nitens, Carex viridula, C. nigra, C. dioica, C. panicea, Juncus subnodulosus, Molinia caerulea, Hydrocotyle vulgaris, Ranunculus flammula, Mentha aquatica, Galium palustre, Parnassia palustris, Pinguicula vulgaris | Topogenous fens in valleys or depressions; within transition mire and tall reed beds; calcium rich flush areas in blanket bogs; dune slack areas; wet hollows in machair |
| Poor Fen | NA | 544 Acidic fens | PF2 Poor fen and flush | Caricetalia nigrae | Hammarbya paludosa, Juncus effusus, Carex rostrata, C. nigra, C. curta, Sphagnum recurvum, S. teres, Calliergon stramineum | Poor fen flushes in blanket bog; soligenous depressions among grassland, cutover bogs and heath |
| Non-Calcareous spring | NA | 541 Springs Montio-Cardaminetea; 5411 Soft Water springs Montio-Cardaminetea | FP2 Non-Calcareous Springs | Montio-Cardaminetea | Saxifraga hirculus, Sphagnum auriculatum, Calliergon sarmentosum, Polytrichum commune, Juncus bulbosus, Viola palustris, Ranunculus flammula, Hydrocotyle vulgaris | Cold springs, commonly dominated by bryophytes within blanket bog complexes |

6.2.6 Fen habitats area estimation on sites

Following the compilation of the list of sites that contained (or were believed to contain) one of the six fen types being recorded as part of the NPWS Fen Study, it was necessary to obtain an accurate or estimated figure for the extent of the relative fen vegetation type(s) present on each site.

On certain sites an accurate extent value for the extent of fen present was held in digital form in various NPWS databases consulted (i.e. Derwin 2003/04) or was available directly from site descriptions. The Management Planning Services Unit (MPSU) section in NPWS were also able to provide exact digitised area data for 25 sites.

However, in the case of over 600 sites (75% of sites in database) it was necessary to re-examine written NHA sites files or Natura 2000 data forms for the SAC to obtain area information for each of these sites.

In many cases (i.e. the majority of NHAs) the area of fen habitat present within a site was only provided as an approximate area estimate (i.e. <5%; 5-20%; 21-50% or greater than 50%). In the case of NHAs, the following percentage figures were used to calculate the estimated area of fen on the site, based on the NHA area presented in the NHA site file: <5% (2.5% estimate of fen area on site); 5-20% (10% estimate of fen area on site); 21-50% (25% estimate of fen area on site) or greater than 50% (50% estimate of fen area on site). In general, the specific percentage value used to calculate the extent of fen on a site, and the specific source of same (i.e. NHA, CORINE or SAC file data) is recorded in the "Habitat Information/Area comments" field associated with each site in the NPWS Fen study database.

Where no previous estimation of the extent of fen habitat had been made on a site, the author re-examined written records and maps for each of the sites in question and "guesstimate" a figure for the area of fen present, where the site description made this possible. Where the site description provided no evidence for the extent of fen on the site no area data was presented for the site.

Data on the extent of fen habitats within a site was obtained from:

- ◊ MPSU digital site area data
- ◊ Derwin blanket bog site area data
- ◊ NHA site files where the area of fen vegetation was provided on the 1-4 extent scale described above
- ◊ CORINE site information where fen vegetation was given as a % of the total site area
- ◊ SAC Natura 2000 forms and Explanatory Notes where area of fen vegetation was given as a % (minimum possible 1%)
- ◊ Directly from written site records where reference was made to the specific fen area present

Where a number of sub sites occurred within a single NHA or SAC complex (for which an area estimate of fen habitats has also been undertaken) the area of fen within the Site Complex main record was adjusted to take account of the area of fen habitat present within the various Site Complex sub units. This adjustment was undertaken to ensure that the area of fen was not duplicated within the database and subsequent area calculations.

6.2.7 National information survey for undesignated fen sites

As one of the aims of the Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland was to identify sites and areas where conservation worthy fens exist that were outside the NHA/SAC network a formal request for information was sent to a variety of groups and individuals (both within and outside NPWS) who might hold information on such fen areas.

The list of interest groups and individuals who were consulted is provided in Appendix 2, while those who provided information to the present study is provided in Appendix 3.

Following the compilation of the list of sites from these external sources, where possible, an area figure or estimate for the extent of the relative fen vegetation type(s) present on each site was made from site descriptions or measurements made by the recorder who submitted the site for inclusion in the NPWS Fen Study database.

6.2.8 Compilation of NPWS Fen Study Database

A specific NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland database was created at the outset of this project to hold data on the fen sites recorded during the course of this study.

In summary the main NPWS Fen Study database held information on site provenance, site names, county, SAC and NHA codes, national grid reference, site conservation designations, habitat information on the specific fen vegetation type(s) present and the area of each (or an estimate where no accurate data was available), information on rare species of note, a summary of published reports holding information on the site, and a site evaluation section which ranked each site in terms of its conservation importance, area information, survey information, and survey priority (For a full list of data fields recorded in the NPWS Fen Study database see Appendix 5).

Two secondary relational databases (linked to one together by use of site record number and reference code number), holding a list of reports and publications referring to fens within the database, and a publications / report site records database, make up the complete NPWS Fen Study database.

Where a site was a newly proposed area outside the NHA/SAC network site information report and the name of the proposer were stored.

An overview of the main data entry layouts used in the NPWS Fen Study database are illustrated in Appendix 6.

The database was created using the Filemaker Pro 8 database package which runs on both PC and Mac platforms.

Where possible relevant data was imported into the NPWS fen database, though due to the variability of data sources this was not always possible, in which case manual re-entry of information was undertaken.

6.2.10 Fen site evaluation

To provide a summary of data held on sites within the NPWS Fen Study database, sites were evaluated under four themes namely: the conservation importance of a site based on the fen habitat(s) present; the availability of accurate information on the type of fen communities present within the site; the availability of accurate area information on the extent of fen habitat(s) within the site and the need for a detailed survey of the site.

A number of factors were considered in the subjective ranking of sites under each of these themes. The factors considered are detailed in the appropriate section below. Due to the nature of the data the evaluation is primarily subjective, rather than empirical.

Sites were evaluated on the following criteria:

6.2.10.1 Conservation importance of site for the fen habitat(s) present

Factors that were considered under this theme when evaluating sites, based on data held in the NPWS Fen Study database, included:

- ◊ the extent of fen habitat(s) present and whether this was significant in relation to known total area of this habitat type in Ireland;
- ◊ the presence of Annex 1 Habitats Directive priority habitats;
- ◊ the presence of Annex 2 Habitats Directive species;
- ◊ presence of other rare species of flora and fauna;
- ◊ the geographic location;
- ◊ the rarity of this habitat type within a given county;
- ◊ the designation of the site as Annex 1 fen SAC.

A three point ranking scheme was used: namely sites with Low conservation Value; Medium conservation Value; High conservation Value.

In terms of this ranking scheme, it should be noted that all fen sites listed within the NPWS Fen Study database are known or believed (in the case of newly reported sites) to have a conservation value.

Sites were considered to have Low conservation Value where they contained only a limited area of fen vegetation; without Annex 1 priority status fen habitats or rare species present; and/or where other similar but more extensive fen type sites occurred within the same geographic area.

Sites were considered to have Medium conservation Value where they contained a more substantial areas of fen vegetation; or a small area of Annex 1 priority status fen habitat and/or where other similar but more extensive fen type sites occurred within the same geographic area.

Sites were considered to have High conservation Value where they contained an extensive area of a given fen vegetation type; and/or held Annex 1 priority status fen type(s) or Annex 2 species or other rare species; and/or where they were considered rare in a geographic context; and had already been designated as an Annex 1 fen SAC site.

6.2.10.2 Survey information and fen habitat type present on sites

Factors that were considered under this theme when evaluating sites, based on data held in the NPWS Fen Study database, included:

- ◊ confusion over the particular fen type believed to be present on a given site (based on written reports and available documentation);
- ◊ disagreement between habitat classification based on the Fossitt scheme and other site accounts;
- ◊ lack of a good quality habitat description.

A three point ranking scheme was used: namely sites which were Not studied; Poorly studied; Adequately studied.

Sites were considered to be Not studied where no basic description was available; and/or where there was confusion over the fen type(s) present on the site. This ranking in particular applied to some of new reported and as yet undesignated fen sites.

Sites were considered to be Poorly studied where only a basic description only was available; and/or where confusion existed over one or more of the fen type(s) present on the site and most had to be assigned to the "possible fen type " present category.

Sites were considered to be Adequately studied where a basic description was available; and/or where this was pre-1990; and where certainty existed over occurrence of the fen types on the site (allowing assignment to the "confirmed" fen type category); and at most uncertainty existed over one fen type present on the site.

6.2.10.3 Accuracy of area information on fen habitat present on sites

Factors that were considered under this theme when evaluating sites, based on data held in the NPWS Fen Study database, included:

- ◊ availability of information on the extent of a particular fen type present on a given site;
- ◊ confusion over the relative extent of fen types when two or more occurred within a site;
- ◊ only estimate data on the extent of fen type(s) available for a site;
- ◊ accurate MPSU or other mapped data on the extent of fen types was available.

A four point ranking scheme was used: namely sites which had No area information; Limited estimated area information; Some area information; Complete accurate area information.

Sites were considered to have No area information where extent information on fen types was completely lacking; and/or where descriptions gave no indication of the extent of fen vegetation within a site.

Sites were considered to have Limited estimated area information where extent information on fen types had been roughly estimated (percentage value); and/or where descriptions gave some indication of the extent of fen vegetation within a site; but where extent one or more of the fen types present could not be estimated.

Sites were considered to have Some area information where information on the extent of all fen all types present had been estimated to at least a rough percentage value; and/or where site descriptions gave a general indication of the extent of all fen habitats within a site.

Sites were considered to have Complete accurate area information where precise digitised or mapped extent of all fen habitat types within the site was known.

6.2.10.4 Need for a detailed fen survey of sites

Factors that were considered under this theme when evaluating sites, based on data held in the NPWS Fen Study database, included:

- ◊ availability (or lack) of information on the fen type(s) and extent of fen habitat(s) present on site;
- ◊ the presence of Annex 1 Habitats Directive priority habitats;
- ◊ presence of rare species of flora and fauna;
- ◊ the geographic location of the site;
- ◊ newly reported site requiring survey;
- ◊ date of last known survey;
- ◊ quality and number of known surveys of site and recommendations made regarding need for an additional survey within these reports;

A three point ranking scheme was used: namely sites with a Low survey priority; Medium survey priority; High survey priority.

Sites were considered to have Low priority for a field survey where the site had been well and /or repeatedly studied; and/or where surveys were recent; and/or where accurate data on fen type(s) present and their extent was known; and/or where no Annex 1 fen habitats occurred; and/or where fen vegetation present had a low conservation value.

Sites were considered to have Medium priority for a field survey where the site had been poorly studied; and/or where surveys were pre-1990; and/or where accurate data on fen type(s) present and their extent was unclear; and/or where no Annex 1 fen habitats occurred; and/or where fen vegetation present had a medium conservation value.

Sites were considered to have High priority for a field survey where the site had been newly reported; and/or where no survey data was available; and/or where accurate data on fen type(s) present and their extent was absent or confusion existed; and/or where Annex 1 fen habitats occurred; and/or where fen vegetation present had a high conservation priority.

6.3 The location of potential new fen sites in Ireland

One aim of the current NPWS Fen Study was to identify zones or counties where additional fen sites of conservation value might be located but which have not yet been identified through field surveys.

To identify these potential fen site locations, two main approaches (a county wetland analysis and digital fen peat soil analysis) were adopted as part of the NPWS Fen Study. These analyses were conducted independently of each other, and the findings from each, were then combined to produce the final list of counties recommended as a priority for field survey in the future.

6.3.1 County wetland analysis

The first approach taken was a county wetland analysis to identify the suitability of each county for the occurrence of additional fens, ranging from alkaline to more acid fen types.

This ranked counties on their past and present wetland (fen and peat) resource status (i.e. the presence and extent of suitable wetland systems where fens might occur), soil type, geology and geomorphological land form suitability, past survey work on wetlands that might have revealed the locations of fens, the number of lakes and their overall extent within each county, and the number of new fens notified by researchers as part of the present NPWS Fen Study.

Based on a combination of these factors, counties were ranked on the likelihood that a detailed fen field survey might yield additional fen sites, both alkaline and more acid in nature, of conservation value.

The factors that were considered in this county analysis included:

the original extent of fen within the county after Hammond (1979); this data indicated counties where suitable conditions for the occurrence of fen existed in the past and would be likely to occur today, provided the impact of anthropogenic factors (i.e. drainage, land reclamation) had not been too severe.

the extent of fen within the county after IPCC (2001); this data indicated counties where suitable conditions for the occurrence of fen existed in the past, and when taken together with the original fen extent provided by Hammond (1979) give an indication of the severity of the anthropogenic impact on the decline of fen habitats to date.

the extent of peatlands (raised and blanket bog) within the county after Hammond (1979); this factor provided information on the likely occurrence of suitable local conditions, within both intact and degraded peatlands, for the occurrence of a range of fen habitats including poor fen, alkaline fen, transition mire and spring fens.

county soil type, geology and geomorphological features; where alkaline or acid rocks are exposed; limestone boulder clay or acid soil deposits and glacial land form features (e.g. drumlins, glacial outwash plains, eskers etc.) occur, these features alone or in combination provide suitable conditions for the occurrence of a range of fen types.

wetland surveys (e.g. peatland, river, lake, pre-drainage) that have been conducted within the county to date; a review of existing county surveys conducted on a range of wetland types, provided an indication of the number of fens that are likely to have been discovered during the course of these wetland studies to date, and gave an indication of counties where surveys were scarce, and additional undiscovered sites might occur.

the extent of fen within the county after the NPWS Fen Study 2007; this data would indicate counties where suitable conditions for the occurrence of fen exist at present, for

both alkaline and acid fen types, and provided an indication of the severity of the impact of anthropogenic factors in the decline of fen habitats from the fen area provided by Hammond (1979).

the number of new undesignated and new cNHA sites reported to the present NPWS Fen Study by county; although limited by the availability of local research expertise, counties from which new sites had been reported might be likely to yield further additional fens of conservation value following detailed survey.

wetland and/or fen surveys due to be undertaken by county; this data gives an indication that local researchers and conservation personnel believe that fens of conservation value remain to be discovered.

number of lakes and extent by county; this data gives an indication of the overall suitability of a county for the occurrence of certain fen types that occur in association with freshwater habitats.

6.3.2 Digital fen peat soil and wetland distribution analysis

The second analysis, aimed to locate zones where alkaline fen types in particular might be likely to occur. This analysis examined the digitally mapped distribution of the areas of alkaline fen peat after Hammond (1979), alkaline fen soils from Teagasc (2006), areas identified in Commonage framework plan surveys as "fen-marsh-swamp", and the Corine 2000 land cover map for "inland marshes", against a mapped overlay of known NHAs, SACs and all fen sites identified during the present NPWS Fen Study.

It was hypothesised that those areas throughout the country, where fen peat occurred, but which showed an absence of conservation worthy sites (NHA, SAC), and lack of fen sites reported from the present study, might indicate zones where future field surveys would be likely to locate additional alkaline fen sites of conservation value, assuming local ecological conditions continued to exist that were suitable for the development of fens.

Once digital maps had been produced, incorporating this fen soil and site data, they were examined in detail and areas with fen peat deposits but without any fen conservation areas were selected. Counties were then ranked on the extent of the potential fen areas identified.

Finally, the results from these two analyses were combined to rank counties on the probability that additional fens would be identified as part of a future fen field survey.

7. Results

7.1 Present extent of fens in Ireland

The data collection period for the compilation of the sites held within the NPWS Fen Study database was from the 8 June 2006 to 17 November 2006, at which point a final Fen Study Database 2007 (Version 1.0) was created from which the results presented below were calculated. The site lists presented in Appendix 9 are also produced from Version 1.0 of the NPWS Fen Study database.

An updated version of the database (Version 1.1) was created during December 2006 which contained minor data corrections and corrections to site national grid references. A pre-existing error in the grid reference data imported, in particular from the NPWS Database, was discovered during the mapping of sites using numeric grid reference data (see section 7.2.2) and had to be corrected. Version 1.1 of the NPWS Fen Study database is included on the CD included with this report.

7.1.1 Limitations of the data:

A number of difficulties and limitations with respect to the compilation of the NPWS Fen Study list of fen sites were encountered, which the reader should be aware of, before interpretation of the data is undertaken and to provide an estimate of the level of confidence that can be applied to the data from the current study.

Fen site identification

Although every effort was made to compile a complete list of all fen sites in Ireland, from data held both within NPWS and from external sources, it is very probable that additional fen sites do occur nationally which have not been included within the NPWS Fen Study database. This assumption is supported by the number of newly reported fen sites that have been submitted to NPWS for conservation consideration from such studies as Crushell (2000), or independently of any specific survey, and during the course of this study. Therefore the list of sites presented here should not be regarded as definitive.

Primarily this lack of site identification is due to the absence of any national fen survey to date. In addition our knowledge of the potential location of fen sites, may also be incomplete, due to the patchy nature of previous bog and wetland surveys around the country.

In the case of sites within NPWS, a limited number of additional fen sites may also have been overlooked, as habitat classification currently identifies these as some other non-fen wetland type (e.g. sites classification as reed swamp, marsh or tall herb swamp).

It is also likely that some earlier NPWS habitat or regional reports, for which data was never fully collated, and which were not consulted during this data collection exercise due to time constraints, may contain information on additional fen sites (e.g. pre-drainage survey data for selected river systems).

Fen habitat type classification

During the selection of fen sites, it was not always possible to ascertain with complete certainty, which of the 6 fen types recognised in this survey, were present on a given site. In other cases, where more than one fen type occurred within a site, there may have been uncertainty about the possible occurrence of one or more of the fen types, while others were clearly confirmed as present.

This resulted in the classification of fen habitats on some sites in the NPWS Fen Study

database into a "possible" fen type category. This estimate of the fen type present was made from the available habitat description and/or the presence of other fen and non-fen habitats on the site.

For the purposes of the presentation of results, both possible and confirmed fen type(s) occurrence on sites will be dealt with as one and the same.

In NPWS Fen Study database approximately 33% (268 site records) of the site records include some uncertainty over the presence of one or more fen habitat types.

Estimation of the extent of fen habitats on recognised sites

Lack of accurate data on the extent of fen habitat(s) within the majority of sites means that it was only possible to estimate a value for the area (in ha) of each fen type(s) within a site. Such data was recorded in an "estimated" area extent field for each fen type within the database. This problem was often compounded when more than one fen type was recorded on a site but no distinction was made between them and only a single area figure of "fens & flushes" communities on the site was presented by previous surveyors.

Accurate data for the area of some or all of the fen types recorded within a given site came from detailed site descriptions for a limited number of site records, from data provided by MPSU (NPWS Management Planning Services Unit), the detailed notes on Natura 2000 data form Explanatory Notes and area calculation for blanket bogs sites in the Derwin (2003) report.

In NPWS Fen Study database approximately 13% (101 sites) of the site records include complete accurate area data for one or more fen categories recognised. Of the remaining sites, 13% (102 sites) have no fen area extent information, while the remaining 75% (605 sites) of sites have only estimated fen habitat extent areas quoted.

For the purposes of the presentation of results, area information (accurate and estimated) for the various fen types on sites will be presented and discussed together.

Lack of any site data on extent

One other issue should be borne in mind during the interpretation of the data on the extent of fens, concerns the complete lack of site data on the extent of fen vegetation present, in particular for some of the newly discovered and reported fen sites that have no current conservation designation or have been included in the candidate NHA (cNHA) category.

Due to lack of detailed site survey data it was only possible to list the site, with the occurrence of an appropriate fen type - without being able to provide any data on the extent of the fen type(s) recorded. It should be noted however, that the majority of these sites are relatively small, and that the missing data on extent may not significantly increase the overall area of fen estimated within the scope of this report.

In NPWS Fen Study database approximately 13% (102 sites) of the site records have no data on the extent of the fen habitat(s) recorded on the site.

7.1.2 Summary findings on the extent of fens in Ireland:

Following the NPWS Irish Fen Study a total of 808 sites have been identified which contain (or are believed to contain) one of the 6 fen types recognised in the present study. A site record has been created for each of these with the NPWS Fen Study database.

Within the total of 808 records in the Fen Study database, 681 sites are unique (e.g. NHA, cNHA, SAC, cSAC or newly identified undesignated sites outside of existing conservation areas), while the remaining 127 site records are sub sites found within existing or proposed NHA or SAC (see Appendix 9 for a list of all sites within the NPWS Fen Study database).

The 808 sites within the NPWS Fen Study database contain an estimated 22,180 ha of fen vegetation. Table 7.1 below shows the number of sites and the extent of the six fen habitat types recorded during this study in Ireland.

The most extensive fen type is poor fen with a total estimated area of 11,841 ha. The abundance of this poor fen type is explained by its occurrence in many blanket bog areas, of which a minimum of 166,000 ha of intact and conservation worthy peatland still exists in Ireland (IPCC 2001).

Spring type fen vegetation, whether alkaline or non-calcareous in nature is still the least abundant in terms of area (36 ha and 32 ha respectively).

From the data obtained in the NPWS Fen Study it would appear that earlier NPWS estimates of the national extent of the different fen type (O Críodáin 1995) were overestimated for some and underestimated for other fen types.

From the results of this study it would appear that we have considerably more Petrifying Spring than the 0.5 ha estimated in 1995. This study has produced an estimated figure of 36 ha for this fen type nationally in 112 sites.

In terms of the number of sites, the present NPWS Fen Study has therefore almost doubled the number of fen sites previously recorded in Ireland (IPCC 2001; NPWS 2006 data). Fens are therefore more common (in terms of the number of sites) than previously thought. Although this statement should be qualified by stating that, in the case of the old NPWS database this did not list sub-sites within the larger NHA/SAC complexes.

Of the total 22,180 ha of fen habitat recorded in Ireland, only 10,307 ha are Annex 1 fens (Cladium fen 7210, Alkaline Fen 7230, Transition Mire 7140 and Petrifying Spring 7220). The remaining 11,873 ha are Poor fen and Non-calcareous spring (see Table 7.1). Table 7.3a below shows the extent of Annex 1 fens and the total area for all habitat fen types (including Poor fen and Non-Calcareous spring) recorded during this study in Ireland on a county basis.

These data show that western counties (e.g. Clare, Donegal, Galway, Limerick, Mayo) have extensive fen areas, along with Offaly and Tipperary. Conversely eastern counties (e.g. Carlow, Louth, Wicklow, Wexford, Waterford, Monaghan and Meath) tend to have smaller fen areas. This trend is generally maintained when either Annex 1 fen types or all fen type extent data is considered.

To allow more direct comparison of the extent of fens in Ireland between the current and past studies, the extent of fens recorded in this study has been presented without, and including the area of Poor fen and Non-calcareous spring present on a county basis in Table 7.3b. The figure excluding poor fen data most closely resembles that of previous studies, where this fen type was not recorded, and represents Annex 1 fen types. Table 7.3b below compares the extent of Annex 1 fens and the total area for all habitat fen types (including Poor fen and Non-Calcareous spring) recorded during this study in Ireland on a county basis, with previous data on fens from Hammond (1979) and IPCC (2001).

The Annex 1 total fen area figure recorded in this study (10,307 ha), is considerably less than the 19,660 ha of this group of fen habitats recorded by the most recent fen study undertaken by the IPCC (Foss et al. 2001). One factor which may help to explain this discrepancy is that previous IPCC data included entire site areas or larger proportion of each site as fen habitats, which is not the case in reality, where strictly defined fen vegetation is often only a minor portion of the entire site (often not exceeding 5-10% of total site area).

When data from the present study is compared with that from IPCC (2001) (see Table 7.3b) it can be seen that all counties have a smaller extent of Annex 1 fen present as revealed by this study than that estimated by IPCC in 2001. Exceptions to this occur in only counties Clare, Limerick and Offaly where this study has revealed a greater area of Annex 1 fen communities than reported by IPCC.

Conversely this study would seem to indicate that we have considerably less fen area than previously predicted for Annex 1 fen types. This study has produced an estimated figure of 1,486 ha for Cladium fen (previous estimated extent 2,500 ha O Críodáin 1995); 1,955 ha for Transition mire (previous estimated extent 6,000 ha in 1995); and 6,830 ha for Alkaline fen (previous estimated extent 12,000 ha in 1995).

Meanwhile Table 7.2 below, further analyses the occurrence of fens on a county basis and shows the extent of each of the six fen habitat types recorded during this study in Ireland on a county basis.

As can be seen from this table, certain fen types (i.e. Cladium, poor and non-calcareous springs) may only be represented by a single or low number of site occurrences within certain counties, a factor which might increase the conservation value of these sites. Other fen types with a high representation of sites and fen area in a given county (or adjacent counties) indicate counties which can be regarded as the headquarters for certain fen type (e.g. poor fens in Donegal, Galway, Kerry, Cork and Mayo).

Table 7.1: The number of sites and the fen extent (ha) of the fen habitats recognised in Ireland by the NPWS Fen Study 2007

| NPWS Fen Study Type | Number of sites | Fen Area (ha) |
|--|-----------------|---------------|
| *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davalliana</i> 7210 (PF1) | 122 | 1,486 |
| Alkaline fens 7230 (PF1) | 380 | 6,830 |
| Poor fens (PF2) | 379 | 11,841 |
| Transition mires and quaking bogs 7140 (PF3) | 173 | 1,955 |
| * Petrifying springs with tufa formation (<i>Cratoneurion</i>) 7220 (FP1) | 112 | 36 |
| Non-Calcareous springs (<i>Montio Cardaminetea</i>) (FP2) | 33 | 32 |
| Total | | 22,180 |

Table 7.2: The extent of fen habitats recognised in Ireland within each county in the NPWS Fen Study 2007. Area in ha with the number of sites in brackets*.

| County | * Cladium fens 7210 (PF1) | Alkaline fens 7230 (PF1) | Poor fens (PF2) | Transition Mires 7140 (PF3) | * Tufa springs 7220 (FP1) | Non-Calcareous Springs (FP2) |
|-----------|---------------------------|--------------------------|-----------------|-----------------------------|---------------------------|------------------------------|
| Clare | 303 (15) | 856 (25) | 199 (10) | 149 (13) | 7.92 (10) | 0.1 (1) |
| Cavan | 0 (1) | 120 (7) | 274 (6) | 0 (1) | 0.1 (3) | |
| Carlow | 4 (2) | 4 (1) | 50 (1) | | 0.01 (1) | |
| Cork | 24 (3) | 501 (17) | 2,154 (17) | 43 (8) | 5.6 (3) | 10.8 (4) |
| Donegal | 21 (5) | 365 (25) | 1,612 (66) | 375 (16) | 1.01 (2) | |
| Dublin | | 61 (3) | 9 (1) | | 0.1 (2) | 0.03 (3) |
| Galway | 356 (29) | 1,282 (50) | 1,556 (51) | 426 (23) | 7.6 (17) | 1.3 (1) |
| Kildare | 84 (4) | 147 (11) | 19 (4) | 2 (3) | 1.3 (8) | 0.11 (3) |
| Kilkenny | 6 (4) | 118 (7) | 0 (1) | 3 (2) | 1.9 (7) | |
| Kerry | 10 (2) | 183 (9) | 2,172 (31) | 1 (4) | 5.6 (4) | 5 (2) |
| Longford | 0 (2) | 156 (7) | 69 (6) | 13 (2) | | |
| Louth | 3 (2) | 61 (6) | 100 (2) | 1 (3) | 0 (1) | |
| Leitrim | | 164 (6) | 316 (13) | 59 (11) | 0.3 (2) | 0.5 (1) |
| Laois | 10 (2) | 158 (10) | 50 (2) | 0.1 (2) | 1.12 (5) | 1 (2) |
| Limerick | 127 (13) | 436 (14) | 309 (5) | 19 (3) | 0.16 (2) | |
| Meath | 36 (4) | 81 (16) | 13 (3) | 13 (3) | 0.12 (5) | 0 (1) |
| Monaghan | 6 (3) | 9 (4) | 50 (16) | 126 (14) | 0.1 (1) | |
| Mayo | 249 (16) | 566 (34) | 3,501 (62) | 548 (22) | 1.91 (10) | 0.5 (4) |
| Offaly | 14 (5) | 1,955 (38) | 559 (21) | 25 (7) | 2.67 (10) | |
| Roscommon | 41 (5) | 386 (23) | 257 (22) | 2 (3) | 1.01 (4) | |
| Sligo | 0 (1) | 261 (20) | 304 (16) | 13 (11) | 2.54 (11) | 0.2 (1) |
| Tipperary | 163 (7) | 1,080 (19) | 279 (17) | 16 (6) | 6.13 (7) | 15.6 (4) |
| Westmeath | 11 (11) | 316 (56) | 68 (5) | 95 (14) | 1.31 (8) | 0.1 (1) |
| Wicklow | 60 (3) | 110 (8) | 340 (6) | 30 (2) | 6.52 (9) | 1.99 (2) |
| Wexford | 0 (2) | 63 (9) | 53 (3) | 6 (1) | 0.11 (2) | 0.1 (1) |
| Waterford | 0 (1) | 207 (11) | 75 (11) | 4 (6) | 0.01 (1) | 0.1 (1) |

* The data presented in this table includes a limited number of sites which cross one or more county boundaries. In such cases the area data and site is duplicated for the occurrence of the site in each of the respective counties in which it occurs.

Table 7.3a: The extent (ha) and number of fen sites recognised in Ireland within each county. *

| County | Fen area (ha) NPWS Fen Study 2007 Annex 1 fens | Fen area (ha) NPWS Fen Study 2007 All fen types | Total number of sites NPWS Fen Study 2007 | Number of new undesignated and recent cNHA sites NPWS Fen Study 2007 |
|--------------------|--|---|---|--|
| Clare | 1,316 | 1,515 | 48 | 10 |
| Cavan | 120 | 394 | 12 | 0 |
| Carlow | 8 | 58 | 3 | 0 |
| Cork | 584 | 2,737 | 41 | 4 |
| Donegal | 761 | 2,373 | 84 | 6 |
| Dublin | 62 | 71 | 8 | 3 |
| Galway | 2,072 | 3,629 | 112 | 22 |
| Kildare | 235 | 254 | 18 | 5 |
| Kilkenny | 128 | 128 | 12 | 3 |
| Kerry | 200 | 2,376 | 36 | 3 |
| Longford | 169 | 238 | 13 | 1 |
| Louth | 65 | 165 | 8 | 4 |
| Leitrim | 223 | 539 | 23 | 8 |
| Laois | 169 | 220 | 13 | 2 |
| Limerick | 582 | 891 | 29 | 15 |
| Meath | 130 | 143 | 21 | 5 |
| Monaghan | 140 | 190 | 30 | 18 |
| Mayo | 1,365 | 4,866 | 91 | 16 |
| Offaly | 1,997 | 2,556 | 44 | 19 |
| Roscommon | 430 | 687 | 40 | 4 |
| Sligo | 276 | 580 | 40 | 12 |
| Tipperary | 1,264 | 1,559 | 38 | 7 |
| Westmeath | 490 | 558 | 68 | 37 |
| Wicklow | 206 | 548 | 20 | 1 |
| Wexford | 69 | 122 | 11 | 2 |
| Waterford | 211 | 286 | 20 | 11 |
| Total Study | 10,307 | 22,180 | 808 | 213 |

* The NPWS Fen Study data presented in this table includes a limited number of sites which cross one or more county boundaries. In such cases the area data and site is duplicated for the occurrence of the site in each of the respective counties in which it occurs, but is not included within the table study totals.

National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007 by Peter Foss

Table 7.3b: Comparison of the extent (ha) of fen sites recognised in Ireland within each county based on the current and past studies *.

| County | Fen area (ha) NPWS Fen Study 2007 Annex 1 fens | Original fen area (ha) after Hammon d 1979 | Area (ha) of fen after IPCC 2001 | Fen area (ha) NPWS Fen Study 2007 All fen types | Number of sites NPWS Fen Study 2007 | Number of sites after IPCC 2001 |
|-----------|--|--|----------------------------------|---|-------------------------------------|---------------------------------|
| Clare | 1,316 | 7,883 | 806 | 1,515 | 48 | 16 |
| Cavan | 120 | 81 | 340 | 394 | 13 | 9 |
| Carlow | 8 | 0 | 90 | 58 | 3 | 3 |
| Cork | 584 | 0 | 893 | 2,737 | 41 | 13 |
| Donegal | 761 | 0 | 1,318 | 2,373 | 84 | 14 |
| Dublin | 62 | 0 | 96 | 71 | 8 | 3 |
| Galway | 2,072 | 10,012 | 2,419 | 3,629 | 112 | 34 |
| Kildare | 235 | 5,844 | 339 | 254 | 18 | 8 |
| Kilkenny | 128 | 316 | 554 | 128 | 12 | 11 |
| Kerry | 200 | 4,654 | 386 | 2,376 | 36 | 11 |
| Longford | 169 | 1,232 | 843 | 238 | 13 | 8 |
| Louth | 65 | 81 | 160 | 165 | 9 | 8 |
| Leitrim | 223 | 16,030 | 399 | 539 | 23 | 13 |
| Laois | 169 | 5,140 | 572 | 220 | 13 | 5 |
| Limerick | 582 | 352 | 437 | 891 | 29 | 19 |
| Meath | 130 | 3,901 | 223 | 143 | 21 | 10 |
| Monaghan | 140 | 0 | 214 | 190 | 30 | 13 |
| Mayo | 1,365 | 469 | 2,460 | 4,866 | 91 | 38 |
| Offaly | 1,997 | 13,901 | 954 | 2,556 | 44 | 14 |
| Roscommon | 430 | 4,828 | 1,650 | 687 | 40 | 21 |
| Sligo | 276 | 1,279 | 475 | 580 | 40 | 26 |
| Tipperary | 1,264 | 4,298 | 1,571 | 1,559 | 38 | 16 |
| Westmeath | 490 | 11,026 | 1,161 | 558 | 69 | 20 |
| Wicklow | 206 | 0 | 543 | 548 | 20 | 12 |
| Wexford | 69 | 566 | 406 | 122 | 11 | 6 |
| Waterford | 211 | 615 | 351 | 286 | 20 | 16 |
| Total | 10,307 | 92,508 | 19,660 | 22,180 | 808 | 367 |

* The NPWS Fen Study data presented in this table includes a limited number of sites which cross one or more county boundaries. In such cases the area data and site is duplicated for the occurrence of the site in each of the respective counties in which it occurs, but is not included within the table totals.

7.1.3 Fens in Ireland designated for SAC Annex 1 Fen Habitats:

One of the obligations placed on Ireland under the EU Habitats Directive was to designate a representative selection of the most important fen sites within the country as Special Areas of Conservation (SAC).

Table 7.4 below shows the extent of and number of sites formally designated and transmitted to the EU as SAC, primarily for their occurrence of one or more of the four Annex 1 Habitats Directive fen types found in Ireland.

In total 68 discrete sites have been formally designated for one or more Annex 1 fen habitat under the EU Habitats Directive (see Appendix 9 for the list of the sites designated as SAC).

The total area of Annex 1 fen habitats within these 68 SAC is estimated at 2,190.3 ha. The percentage of each fen type designated as Annex 1 fen, as a percentage of the estimated national fen resource is also shown in Table 7.4.

In addition to 68 SAC sites formally designated and transmitted to the EU, for one or more of the four fen types in Ireland, a number of additional fen sites are also listed as SAC for fen, for example on the NPWS official web site (November 2006).

These sites, however, contain only a non-significant area of the relevant fen type for which they are listed, in the "D" category of the Natura 2000 Data Form (<1% cover) and have not been included in the SAC data presented in this section (Wyse Jackson pers. comm.).

These sites, listed as SAC under the different fen types, include:

Alkaline Fen 7230: Ross Lake and Woods 001312; Urlaur Lakes 001571; Philipston Marsh 001847; and Ballymore Fen 002313.

Transition Mire 7140: Ballynafagh Lake 001387

The SAC data from this study, presented in Table 7.4, updates that previously presented by Ó Críodáin & Doyle (2003) in which they reported that 3,620 ha of fen in 35 SAC had been protected in SAC in Ireland (see Table 5.6).

Table 7.4: Sites designated as SAC for Annex 1 fen habitats in Ireland by the NPWS Fen Study 2007. Table shows the number of sites and area (ha) of each Annex 1 fen habitat type, and the percentage of national resource of each Annex 1 fen type protected within designated fen SACs.

| NPWS Fen Study Type | Number of sites designated for each Annex 1 fen type | Fen Area (ha) | Percentage of corresponding estimated national fen resource |
|--|--|---------------|---|
| 7210 *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davalliana</i> (PF1) | 17 | 711 | 4.7 |
| 7230 Alkaline fens (PF1) | 37 | 1,025 | 15 |
| 7140 Transition mires and quaking bogs (PF3) | 16 | 444 | 23 |
| 7220 * Petrifying springs with tufa formation (<i>Cratoneurion</i>) (FP1) | 19 | 10.3 | 2.9 |
| Total | | 2,190.3 | |

7.1.4 Fen habitats on cSAC and SAC sites in Ireland:

In addition to the Special Area of Conservation (SAC) proposed principally for the occurrence of one or more of the four Annex 1 fen habitats in Ireland; fen vegetation (including non Annex 1 habitat types poor fen and non-calcareous springs) occurs within a number of other SAC which have been designated for various non-fen habitats or species.

Some of these sites have been formally designated, and information on them transmitted to the EU in which case they are defined as SAC. In the case of sites which are still in the appeals process or have not been formally transmitted to the EU they are defined as candidate SAC (cSAC) in terms of the present study.

In total 362 fen sites within the NPWS Fen Study database are located within SAC or cSAC (see Appendix 9 for a list of all SAC sites within the NPWS Fen Study database, including SAC designated for both fen and other habitats and species).

Table 7.5 below shows the extent of fen communities occurring in cSAC or SAC, in respect of the six fen types recorded during this study in Ireland. The percentage of each fen type, as a percentage of the estimated national fen resource is also shown in Table 7.5.

This data demonstrates that should all the candidate SAC sites make it through the formal designation process, and be transmitted to Europe, a significant proportion (64%) of the total Irish fen resource recognised at present will be afforded protection within the SAC network. With the exception of alkaline fen (7230) the proportion of the various fen types protected will be 50% or more.

The total fen area within the network of SAC amounts to 14,086 which represents 64% of the total known Irish fen resource of 22,180 ha, when poor fen sites are included.

In terms of Annex 1 fens (poor fen area omitted), 5,701 ha of fen is afforded a degree of protection within the SAC network, equal to 55% of the total estimated Annex 1 fen resource in Ireland of 10,307 ha.

Table 7.5: The extent of fen habitats within Special Areas of Conservation (SAC) or candidate SAC recognised in Ireland by the NPWS Fen Study 2007

| NPWS Fen Study Type | Fen Area (ha) | Percentage of corresponding estimated national fen resource |
|---|---------------|---|
| 7210 *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> (PF1) | 1,162 | 7.8 |
| 7230 Alkaline fens (PF1) | 3,152 | 4.6 |
| Poor fens (PF2) | 8,369 | 7.1 |
| 7140 Transition mires and quaking bogs (PF3) | 1,363 | 7.0 |
| 7220 * Petrifying springs with tufa formation (<i>Cratoneurion</i>) (FP1) | 2.4 | 6.7 |
| Non-Calcareous springs (<i>Montio Cardaminetea</i>) (FP2) | 1.6 | 5.0 |
| Total | 14,086 | |

7.1.5 Fen habitats on cNHA and NHA sites in Ireland:

Conservation and protection of wildlife sites outside the SAC network in Ireland is facilitated via a network of Natural Heritage Areas (NHA) as defined under the Wildlife Act 2000.

In 1995 proposals were made to designate more than 1,100 NHA (pNHA) for all habitat types, and these sites were advertised in the national press. In the NPWS Fen Study database 492 sites (14,989 ha fen vegetation), of the total 808 sites listed, were designated as former fen pNHA.

In 2002 the legal powers to allow the statutory designation process and protection of pNHA was introduced. At this point all sites were re-advertised as candidate NHA (cNHA) and opened to appeal from landowners on scientific grounds.

At present 71 sites recorded within the NPWS Fen Study database have completed this designation process and are formally designated as NHA. Within these 71 NHA sites 1,927 ha of fen are formally protected.

A further 292 sites in the NPWS Fen Study database are listed as cNHA with a total fen area of 2,457 ha.

Of this list of sites 167 were former pNHA and are presently under going the formal NHA appeals process and designation.

The remaining 125 cNHA sites have been recently reported to NPWS by a variety of external experts and internal NPWS staff, as of sufficient quality to merit consideration as NHA. These sites have been included in the NHA process and their suitability as NHA is being considered, before they are publicly notified and opened to appeal.

Of the 125 cNHA no information on extent of fen vegetation occurs on 46 of the sites.

It is therefore likely that the total area of fen habitats in this category is likely to increase by several hundred hectares once survey data is available.

Table 7.6 below shows the extent of fen on sites designated as cNHA or NHA which contain one of the six fen types recorded during this study in Ireland. Some of these sites have been designated primarily for their fen interest, while others merely contain fen habitats but have been proposed due to the presence of some other key habitat type or species.

The percentage of each fen type, as a percentage of the respective estimated national fen resource is also shown in Table 7.6. Within the cNHA/NHA group of sites, a significant proportion of the respective national fen resource occurs in the case of Alkaline fens 7230 (30%), Petrifying Springs 7220 (33%), and in particular Non-Calcareous Springs (50%).

The total fen area within the network of 363 NHA (i.e. NHA/cNHA designated sites) amounts to 4,384 which represents 20% of the total known Irish fen resource of 22,180 ha, when poor fen sites are included.

In terms of Annex 1 fens, 2,735 ha is afforded some degree of protection within this NHA network, equal to 27% of the total estimated Annex 1 resource in Ireland of 10,307 ha.

Table 7.6: The extent of fen habitats within Natural Heritage Areas (NHA) or candidate NHA (cNHA) recognised in Ireland by the NPWS Fen Study 2007

| NPWS Fen Study Type | Fen Area (ha) | Percentage of corresponding estimated national fen resource total |
|---|---------------|---|
| 7210 *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> (PF1) | 272 | 18 |
| 7230 Alkaline fens (PF1) | 1,921 | 30 |
| Poor fens (PF2) | 1,632 | 14 |
| 7140 Transition mires and quaking bogs (PF3) | 530 | 27 |
| 7220 * Petrifying springs with tufa formation (<i>Cratoneurion</i>) (FP1) | 12 | 33 |
| Non-Calcareous springs (<i>Montio Cardaminetea</i>) (FP2) | 17 | 53 |
| Total | 4,384 | |

7.1.6 Recently reported undesignated Fen sites in Ireland:

One of the aims of the NPWS Fen Study study was to locate other “new” fen sites that might have a conservation value but which had not yet been notified to NPWS.

Following a national fen survey questionnaire asking a variety of wetland specialists and County Council Heritage Officers to propose potential fen areas of interest, which were outside the NHA or SAC network, a further 88 sites with a fen area of 3,974 ha were submitted for consideration as fen sites worthy of conservation. These are referred to as undesignated sites in the NPWS Fen Study database (see Appendix 9 for a list of undesignated sites within the NPWS Fen Study database).

Table 7.7 below shows the extent of fen sites without any current conservation designation discovered for one of the six fen types recorded during this study in Ireland.

The total fen area within the network of undesignated sites amounts to 3,794 ha which represents 17% of the total known Irish fen resource of 22,180 ha, when poor fen sites are included.

In terms of Annex 1 fens, a total of 1,947 ha occurs within the network of undesignated sites, which represents 19% of the total estimated Annex 1 resource in Ireland of 10,307 ha.

It should be noted that no fen area data exists for 47 of the undesignated sites (53%) reported here, suggesting that the percentage of the national fen total found within this group of sites is likely to increase following future surveys and the compilation of area data.

The 88 undesignated sites reported here, when taken together with the 125 fen sites referred to in the previous section on NHA above, which have only recently been reported to NPWS for consideration as NHA, would indicate that in reality 213 recently reported (undesignated sites and sites already under consideration for NHA designation) sites are being considered for designation as conservation worthy fen areas. This represents 26% of all the sites in the NPWS Fen Study database.

This is a significant fen resource about which our knowledge is very limited in many cases (e.g. no fen area data exists for 93 cNHA and undesignated sites).

Table 7.7: The extent of fen habitats on sites without any current conservation designation in Ireland as reported to the NPWS Fen Study 2007

| NPWS Fen Study Type | Fen Area (ha) | Percentage of corresponding estimated national fen resource total |
|---|---------------|---|
| 7210 *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> (PF1) | 6.1 | 4 |
| 7230 Alkaline fens (PF1) | 1,823 | 2.7 |
| Poor fens (PF2) | 1,846 | 1.6 |
| 7140 Transition mires and quaking bogs (PF3) | 6.2 | 3 |
| 7220 * Petrifying springs with tufa formation (<i>Cratoneurion</i>) (FP1) | 1.1 | 3 |
| Non-Calcareous springs (<i>Montio Cardaminetea</i>) (FP2) | 1 | 3 |
| Total | 3,794 | |

7.1.7 Evaluation of Fens within the NPWS Fen Study Database:

An evaluation of sites within the NPWS Fen Study database was undertaken under four main themes: the conservation importance of a site based on the fen habitat(s) present; the availability of accurate information on fen communities within the site; the availability of accurate area information on the extent of fen habitat(s) within the site and the need for a detailed survey of the site. Criteria considered in the evaluation of sites is provided in Chapter 6.

7.1.7.1 Conservation importance of site for fen habitat(s) present

Analysis of the sites within the NPWS Fen Study database was undertaken and sites were ranked in terms of their conservation importance for the fen habitats and species present. Details of the criteria used in site assessment are provided in Chapter 6.

The findings of this evaluation process are summarised in Table 7.8 below which shows the number of fen sites, the area of fen (ha) and their ranking in terms of conservation importance within this study in Ireland.

Of the 808 sites identified by the NPWS Fen Study, 282 sites with an fen area of 14,034 ha (63% of the total fen area identified in this study) have been listed as having a high conservation value, in terms of the fen present. These sites generally contained an extensive area of a given fen vegetation type; and/or held Annex 1 priority status fen type(s) or Annex 2 species or other rare species; and/or were considered rare in a geographic context; and in many cases have already been designated as an Annex 1 fen SAC site.

Table 7.8: Conservation importance of sites for fen habitat(s) present as recognised by the NPWS Fen Study 2007

| Conservation Importance | Number of sites | Fen Area (ha) |
|---------------------------|-----------------|---------------|
| High Conservation Value | 282 | 14,034 |
| Medium Conservation Value | 210 | 6,370 |
| Low Conservation Value | 316 | 1,776 |
| Total | 808 | 22,180 |

A further 210 sites, with a fen area of 6,370 ha (29% of the total fen area identified in this study) have been listed as having a medium conservation value, in terms of the fen present. These sites generally contained significant areas of fen vegetation; or a small area of Annex 1 priority status fen habitat and/or occurred in the same geographic area as sites with similar but more extensive fen areas, or were reported to be of conservation value by recent proposers of the site.

Finally, 316 sites, with a fen area of 1,776 ha (8% of the total fen area identified in this study) have been listed as having a low conservation value, in terms of the fen present. These sites generally contained only a limited area of fen vegetation; without Annex 1 priority status fen habitats or rare species present; and where other similar but more extensive fen type sites occurred within the same geographic area.

7.1.7.2 Survey information and fen habitat type present on sites

Analysis of the sites within the NPWS Fen Study database was undertaken and sites were ranked in terms of our knowledge of the fen habitats present. Details of the criteria used in site assessment are provided in Chapter 6.

Table 7.9 below shows the number of fen sites and their ranking in terms of information available on this site within this study in Ireland.

Table 7.9: Survey information and fen habitat type present on sites as recognised by the NPWS Fen Study 2007

| Survey information and knowledge of fen habitat type present on sites | Number of sites | Fen Area (ha) |
|---|-----------------|---------------|
| Not Studied | 108 | 285 |
| Poorly Studied | 276 | 10,813 |
| Adequately Studied | 424 | 11,082 |
| Total | 808 | 22,180 |

Of the 808 sites identified by the NPWS Fen Study, 108 sites (13% of the fens identified in this study) have been listed as not studied, in terms of the fen present. These sites generally lack a basic site description; there is often uncertainty over the fen type(s) present on the site. This ranking in particular applies to some of newly reported and as yet undesignated fen sites (88 in total reported to the present study).

A further 276 sites, with a fen area of 10,813 ha (49% of the total fen area identified in this study), have been listed as poorly studied. These sites have a site description available, but this often lacks detailed reference to fen types, resulting in continued confusion over the fen type(s) present on the site. Alternatively these sites have more than one description available, with conflicting fen habitat types/or classification.

The largest groups of sites identified in this section are the 424 sites, with a fen area of 11,082 ha (50% of the total fen area identified in this study), which have been listed as adequately studied. In general, these sites have a number of site description available, and the fen types present are known, with differing accounts of the site all in agreement on the fen type present.

7.1.7.3 Accuracy of area information on fen habitat present on sites

Analysis of the sites within the NPWS Fen Study database was undertaken and sites were ranked in terms of information available on the extent of fen habitats present. Details of the criteria used in site assessment are provided in Chapter 6.

Table 7.10 below shows the number of fen sites and their ranking in terms of our knowledge on the extent of fen habitats present on the site within this study in Ireland.

Table 7.10: Accuracy of area information on fen habitat present on sites as recognised by the NPWS Fen Study 2007

| Accuracy of area information on fen habitat present on sites | Number of sites | Fen Area (ha) |
|--|-----------------|---------------|
| No Area Information | 102 | 0 |
| Limited Estimated Area Information | 359 | 10,242 |
| Some Area Information | 246 | 9,871 |
| Complete Accurate Area Information | 101 | 2,067 |
| Total | 808 | 22,180 |

Of the 808 sites identified by the NPWS Fen Study, 102 sites (13% of the fens identified in this study) have been listed as having no area information on the fen type(s) present within the site. This ranking in particular applies to many of the newly reported and as yet undesignated (and unsurveyed) fen sites.

The largest number of sites, 359 sites identified in this study, have been listed as having only limited estimated area data available on the fen type(s) present. In the case of these sites extent information on fen types had been roughly estimated (percentage value); or the site descriptions gave some indication of the extent of fen vegetation within a site; but where extent one or more of the fen types present could not be estimated.

A further 246 sites, with an area of 9,871 ha, have been listed as having some area data available on the extent of the fen type(s) present. On these sites information on the extent of all fen all types present had been estimated to at least a rough percentage value; or site descriptions gave a general indication of the extent of all fen habitats present within a site.

Finally, 101 sites identified in this study, with an area of 2,067 ha (9% of the fen area identified in this study) have complete accurate area information for all the fen types within the sites. This data is available due to precise mapping and digitisation of the extent of all fen habitat types within the site.

7.1.7.4 Need for a detailed fen survey of sites

Details of the criteria used in site assessment are provided in Chapter 6.

Table 7.11 below shows the number of fen sites and their ranking in terms of the need for a detailed field survey within this study in Ireland.

Table 7.11: The need for a detailed field survey of fens sites as recognised by the NPWS Fen Study 2007

| Need for a detailed site field survey | Number of sites | Fen Area (ha) |
|---------------------------------------|-----------------|---------------|
| High Survey Priority | 369 | 12,678 |
| Medium Survey Priority | 227 | 6,222 |
| Low Survey Priority | 212 | 3,280 |
| Total | 808 | 22,180 |

Of the 808 sites identified by the NPWS Fen Study, 369 sites with an fen area of 12,678 ha (57% of the total fen area identified in this study) have been identified as having a high survey priority, in terms of our knowledge of the types and extent of fens present. Sites were considered to have high priority for a field survey where the site had been newly reported; where no survey data was available; where accurate data on fen type(s) present and their extent was absent or confusion existed; where Annex 1 fen habitats occurred; and where fen vegetation present had a high conservation priority.

A further 227 sites with an fen area of 6,222 ha (28% of the total fen area identified in this study) have been identified as having a medium survey priority, in terms of our knowledge of the types and extent of fens present. Sites were considered to have medium priority for a field survey where the site had been poorly studied; where accurate data on some fen type(s) present and their extent was unclear; where no Annex 1 fen habitats occurred; and where fen vegetation present had a medium conservation value.

In term of the NPWS Fen Study, 85% of the area of fen identified (in 596 sites) is therefore listed in the high or medium survey category.

Finally 212 with an area of 3,280 ha sites have been identified as having a low survey priority. Sites were considered to have low priority for a field survey where the site had been well and /or repeatedly studied; or where surveys were recent; where accurate data on fen type(s) present and their extent was known; where no Annex 1 fen habitats occurred; and where fen vegetation present had a low conservation value.

7.2 The location of potential new fens of conservation value in Ireland

7.2.1 County wetland analysis:

To identify counties which might reveal additional fen site of conservation importance as part of a future national survey of this habitat type, an analysis of the different counties in Ireland was undertaken. This analysis aimed to identify counties where both alkaline and acid fen types might be located. Counties were ranked on the probability that additional fens site would be discovered based on available data.

The NPWS Fen Study County analysis is presented in Table 7.12.

A number of local biodiversity, wetland, bog and even fen studies are in progress or being planned in a number of counties in Ireland. The majority of these schemes are being undertaken by County Heritage Officers under the remit of the Heritage Council. In general these studies are being undertaken to obtain information, on bogs, fens and other wetland types, that will feed into local biodiversity plans for these counties.

Counties where fen or wetland surveys are planned or have recently been undertaken include:

- Monaghan - limited wetland field survey undertaken by County Council in 2006; a detailed fen survey planned by County Council for 2007;
- Kildare - Springs survey undertaken in 2005 by County Council;
- Westmeath - Desk-based bogs survey undertake in 2005 by County Council (limited field work undertaken); desk-based fen survey undertaken in 2006 by County Council ;
- Clare - Biodiversity survey of 100 km square around Ennis 2006 by County Council;
- Fingal - Biodiversity survey (including wetland sites) with field work component undertaken in 2006 by County Council;
- Longford - County Council Peatland survey 2006;
- Waterford - County Waterford Wetland Survey undertaken by County Council in 2006.

The results of the county analysis shows that of the twenty six counties in the Republic of Ireland, 11 have been ranked as having a high, or moderate to high probability that additional fens site might be discovered, with a further 3 counties ranked as having a moderate probability.

These recommendations are based on a variety of factors within these counties including a significant past and current area of fen, peat and wetland habitats occurring with the county, the number of new fen sites reported to this study, lack of, or limited county surveys to date, and the suitability of geological, soil and geomorphological land forms present and presence of a significant lake resource.

The counties which are considered to have a high or high to moderate probability, that additional fens will be identified following survey are Clare, Cavan, Galway, Leitrim, Limerick, Monaghan, Mayo, Offaly, Roscommon, Sligo and Westmeath. It is likely that a detailed fen field survey in these counties will reveal a significant number of additional sites of conservation value.

The counties which are considered a moderate probability that additional fens will be identified following survey are Kildare, Longford and Waterford. It is likely that a detailed fen field survey in these counties will reveal a limited number of additional sites of conservation value.

Table 7.12: County wetland analysis. NPWS Fen Study county assessment of the likelihood that additional fens may be located in each county, based on past and present extent of fens and bogs, county surveys to date, soil type, geology and geomorphological land forms and lake area and abundance.

Data Sources Used:

Table 7.12 Part a: County wetland analysis - overall analysis

Original area (ha) of fen by county after Hammond 1979

Area (ha) of conservation fen by county after IPCC 2001

Present area of fen after data held in the NPWS Fen Study database 2007 (Version 1.0)

Table 7.12 Part b: County wetland analysis - wetland studies

NPWS internal reports on raised and blanket bog 1980 - 1990's

Miscellaneous NPWS & external reports, surveys and university studies (full references provided in Report Bibliography)

Table 7.12 Part c: County wetland analysis - soils and geology

National soils and parent material map, Teagasc 2006

Solid Geology Map Geological Survey of Ireland 1975

Table 7.12 Part d: County wetland analysis - lake area and abundance

Environmental Protection Agency Water Framework Directive GIS

Number of lakes present as represented on Discovery series Ordnance Survey maps (scale 1:50,000)

NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007 by Peter Foss
Table 7.12 Part a: County wetland analysis - overall analysis
 Key decision fields in blue

| Probability that additional fens will be discovered based on all data presented - High, Moderate, Low | County | Fen area (ha) after NPWS Fen Study 2007 * | Total No. sites after NPWS Fen Study 2007 * | No. new sites - undesig. & cNHA recent sites * | Original area (ha) of fen after Hammond 1979 | Area (ha) Conservation Fen after IPCC 2001 | Original area (ha) of raised and blanket bogs after Hammond 1979 | Summary Wetland studies within county - Well studied, Moderately studied, Poorly studied (see Part b) | Summary Soils and Geology - suitability for fen occurrence - High, Moderate, Low (see Part c) | Summary lake area and abundance - suitability for all types fen occurrence - High, Moderate, Low (see Part d) |
|---|-----------|---|---|--|--|--|--|---|---|---|
| Moderate/High | Clare | 1515 | 48 | 10 | 7883 | 806 | 53597 | Moderate | High | High |
| Moderate/High | Cavan | 394 | 12 | 0 | 81 | 340 | 10874 | Moderate | Moderate | High |
| Low | Carlow | 58 | 3 | 0 | 0 | 90 | 1047 | Poor | Low | Low |
| Low/Moderate | Cork | 2737 | 41 | 4 | 0 | 893 | 74198 | Poor | Low | High |
| Low/Moderate | Donegal | 2373 | 84 | 6 | 0 | 1318 | 149125 | Moderate | Moderate | High |
| Low | Dublin | 71 | 8 | 3 | 0 | 96 | 469 | Poor | Low | Low |
| High | Galway | 3629 | 112 | 22 | 10012 | 2419 | 149727 | Well | High | High |
| Moderate | Kildare | 254 | 18 | 5 | 5844 | 339 | 18473 | Well | Moderate/High | Low |
| Low/Moderate | Kilkenny | 128 | 12 | 3 | 316 | 554 | 1421 | Poor | Moderate | Moderate |
| Low | Kerry | 2376 | 36 | 3 | 4654 | 386 | 92210 | Well | Low | High |
| Moderate | Longford | 238 | 13 | 1 | 1232 | 843 | 20527 | Moderate | Moderate | High |
| Low | Louth | 165 | 8 | 4 | 81 | 160 | 1012 | Poor | Low | Moderate |
| Moderate/High | Leitrim | 539 | 23 | 8 | 16030 | 399 | 41389 | Moderate | Moderate | High |
| Low | Laois | 220 | 13 | 2 | 5140 | 572 | 15719 | Poor | Low | Low |
| Moderate/High | Limerick | 891 | 29 | 15 | 352 | 437 | 20680 | Poor | High | Moderate |
| Low | Meath | 143 | 21 | 5 | 3901 | 223 | 6388 | Poor | Low | Moderate |
| High | Monaghan | 190 | 30 | 18 | 0 | 214 | 2853 | Moderate | High | High |
| High | Mayo | 4866 | 91 | 16 | 489 | 2460 | 211475 | Well | High | High |
| High | Offaly | 2556 | 44 | 19 | 13901 | 954 | 50245 | Poor/Moderate | High | Low |
| Moderate/High | Roscommon | 687 | 40 | 4 | 4828 | 1650 | 40954 | Moderate | High | High |
| Moderate/High | Sligo | 580 | 40 | 12 | 1279 | 475 | 36224 | Moderate | High | Moderate |
| Low/Moderate | Tipperary | 1559 | 38 | 7 | 4298 | 1571 | 29691 | Poor | Moderate | High |
| High | Westmeath | 558 | 68 | 37 | 11026 | 1161 | 26702 | Moderate | High | High |
| Low | Wicklow | 548 | 20 | 1 | 0 | 543 | 16604 | Poor | Moderate | Low |
| Low | Wexford | 122 | 11 | 2 | 566 | 406 | 162 | Poor | Low | Moderate |
| Moderate | Waterford | 286 | 20 | 11 | 615 | 351 | 11343 | Poor | Moderate | Low |

Comments

* includes some duplicate county cross border area data
 * includes some duplicate county cross border sites

NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007 by Peter Foss

Table 7.12 Part b: County wetland analysis - wetland studies

Key decision fields in blue

| County | Summary Wetland studies within county - Well studied, Moderately studied, Poorly studied (summary) | NPWS Raised bog surveys undertaken | NPWS Blanket Bog surveys undertaken | Other surveys/ studies undertaken with wetland interest that may have revealed information on fen sites (Full title of survey reference can be found in Bibliography) |
|-----------|--|------------------------------------|-------------------------------------|---|
| Clare | Moderate | yes | | Fergus report 1981, Kirby et al 1979, Ennis biodiversity study 2006, |
| Cavan | Moderate | yes | yes | |
| Carlow | Poor | | | |
| Cork | Poor | | | |
| Donegal | Moderate | | yes | NPWS Machair Survey 1983, |
| Dublin | Poor | | | Fingal biodiversity study 2006 |
| Galway | Well | yes | yes | Fergus report 1981, Dunkellin-Lavally river Lockhart 1984, Bleasdale PhD 1995, Lockhart PhD 1991, Conaghan PhD 1995, Mooney PhD 1990, O Criodain PhD 1988; |
| Kildare | Well | yes | | Ecoserve springs 2005, IPCC Bog of Allen survey 2005, |
| Kilkenny | Poor | | | |
| Kerry | Well | yes | yes | Mhic Daeid PhD 1979, |
| Longford | Moderate | yes | | Co Peatland Survey 2006, |
| Louth | Poor | | | |
| Leitrim | Moderate | yes | yes | |
| Laois | Poor | yes | | |
| Limerick | Poor | | | |
| Meath | Poor | | | Ecoserve springs 2005, Fahy 1975, |
| Monaghan | Moderate | | | Finn River 1987, County wetlands survey 2006, Fen Survey planned 2007 |
| Mayo | Well | yes | yes | Lockhart PhD 1991, O Criodain PhD 1988; Foss PhD 1986 |
| Offaly | Poor/Moderate | yes | | |
| Roscommon | Moderate | yes | yes | |
| Sligo | Moderate | yes | yes | NPWS Machair Survey 1983, |
| Tipperary | Poor | yes | | |
| Westmeath | Moderate | yes | | O Connell PhD 1981, Natura wetlands study 2005, Natura fen study 2006, O Criodain PhD 1988, |
| Wicklow | Poor | | | |
| Wexford | Poor | | | |
| Waterford | Poor | | | Natura wetlands survey 2006; |

NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007 by Peter Foss
Table 7.12 Part c: County wetland analysis - soils and geology
 Key decision fields in blue

| County | Summary Soils and Geology - suitability for all types fen occurrence - High, Moderate, Low | Calcareous boulder clay deposits - Widespread, Some, Rare | Drumlin, Esker, Glacial Outwash materials - Widespread, Some, Rare | Limestone bedrock exposure - Widespread, Some, Rare, None | Acid soil deposits - Widespread, Some, Rare | Acid bedrock exposure - Widespread, Some, Rare |
|-----------|--|---|--|---|---|--|
| Clare | High | Some | | Widespread | Some | Some |
| Cavan | Moderate | Some | Widespread | Rare | Widespread | Some |
| Carlow | Low | Widespread | | Rare | Some | Widespread |
| Cork | Low | Widespread | | Some | Some | Widespread |
| Donegal | Moderate | Rare | | Rare | Widespread | Widespread |
| Dublin | Low | Widespread | | Rare | Some | Some |
| Galway | High | Widespread | | Widespread | Widespread | Widespread |
| Kildare | Moderate/High | Widespread | Widespread | Some | Widespread | Rare |
| Kilkenny | Moderate | Widespread | | Some | Some | Some |
| Kerry | Low | Rare | | Some | Widespread | Widespread |
| Longford | Moderate | Widespread | | Some | Some | Rare |
| Louth | Low | Some | | Rare | Widespread | Widespread |
| Leitrim | Moderate | Some | Widespread | Widespread | Widespread | Rare |
| Laois | Low | Widespread | Some | Rare | Some | Some |
| Limerick | High | Widespread | | Widespread | Some | Rare |
| Meath | Low | Widespread | | Some | Some | Some |
| Monaghan | High | Some | Widespread | Rare | Widespread | Some |
| Mayo | High | Some | Widespread | Widespread | Widespread | Widespread |
| Offaly | High | Some | Widespread | Some | Some | Rare |
| Roscommon | High | Widespread | Some | Some | Some | Rare |
| Sligo | High | Some | Some | Widespread | Some | Rare |
| Tipperary | Moderate | Widespread | | Some | Widespread | Some |
| Westmeath | High | Widespread | Widespread | Some | Some | Rare |
| Wicklow | Moderate | Some | | None | Widespread | Widespread |
| Wexford | Low | Widespread | | Rare | Some | Some |
| Waterford | Moderate | Rare | | Rare | Widespread | Some |

NPWS Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland 2007 by Peter Foss
Table 7.12 Part d: County wetland analysis - lake area and abundance
 Key decision fields in blue

| County | Summary lake value - suitability for all types fen occurrence - High, Moderate, Low | Area of county square km | Number of lakes present - As represented on Discovery series maps (scale 1:50,000) * | Lake area in square km | Average lake size in hectares | Percentage County covered by lakes |
|-----------|---|--------------------------|--|------------------------|-------------------------------|------------------------------------|
| Clare | High | 3449,21 | 509 | 154,37 | 30,33 | 4,48 |
| Cavan | High | 1931,75 | 417 | 86,49 | 20,74 | 4,48 |
| Carlow | Low | 896,51 | 36 | 0,12 | 0,33 | 0,01 |
| Cork | High | 7476,94 | 646 | 21,05 | 3,26 | 0,28 |
| Donegal | High | 4840,52 | 1249 | 79,58 | 6,37 | 1,64 |
| Dublin | Low | 804,56 | 62 | 1,24 | 2,00 | 0,15 |
| Galway | High | 6099,11 | 2189 | 465,33 | 21,26 | 7,63 |
| Kildare | Low | 1695,36 | 72 | 20,61 | 28,63 | 1,22 |
| Kilkenny | Moderate | 2072,81 | 129 | 0,38 | 0,29 | 0,02 |
| Kerry | High | 4791,4 | 491 | 64,29 | 13,09 | 1,34 |
| Longford | High | 1091,21 | 60 | 121,52 | 202,53 | 11,14 |
| Louth | Moderate | 826,89 | 101 | 1,05 | 1,04 | 0,13 |
| Leitrim | High | 1590,01 | 250 | 114,84 | 45,94 | 7,22 |
| Laois | Low | 1719,88 | 44 | 0,56 | 1,27 | 0,03 |
| Limerick | Moderate | 2755,86 | 132 | 3,29 | 2,49 | 0,12 |
| Meath | Moderate | 2341,99 | 239 | 22,49 | 9,41 | 0,96 |
| Monaghan | High | 1295,01 | 429 | 22,29 | 5,20 | 1,72 |
| Mayo | High | 5566,69 | 3179 | 340,3 | 10,70 | 6,11 |
| Offaly | Low | 2001,16 | 80 | 1,46 | 1,83 | 0,07 |
| Roscommon | High | 2548,14 | 347 | 209,8 | 60,46 | 8,23 |
| Sligo | Moderate | 1835,73 | 376 | 49,13 | 13,07 | 2,68 |
| Tipperary | High | 4304,64 | 523 | 122,77 | 23,47 | 2,85 |
| Westmeath | High | 1839,58 | 307 | 165,32 | 53,85 | 8,99 |
| Wicklow | Low | 2026,63 | 75 | 25,58 | 34,11 | 1,26 |
| Wexford | Moderate | 2366,73 | 316 | 7,03 | 2,22 | 0,30 |
| Waterford | Low | 1857,26 | 55 | 1,72 | 3,13 | 0,09 |

* data includes lakes that may cross county boundaries

7.2.2 Digital fen soil and wetland distribution analysis:

From the analysis of digital maps, incorporating the areas of fen peat identified by Hammond (1979), fen soils from Teagasc (2006), areas identified in Commonage framework plan surveys as "fen-marsh-swamp", and the Corine 2000 land cover map for "inland marshes", and sites of conservation value (NHA and SAC) data, together with fen sites identified during the current study, a number of zones have been identified where potential alkaline fen sites might be identified following future field survey.

These locations are outlined in green on Figures 7.1 (see Map map sections north, south, east and west).

The counties with the most significant cover of potential fen zones included: Clare, Galway, Kildare, Leitrim, Laois, Mayo, Offaly, Tipperary and Westmeath. Table 7.13 shows the ranking of all counties for their occurrence of potential fen zones, based on this analysis.

The likelihood that additional fens will be found within the zones identified, where fen peat occurs but where there is a lack of known conservation worthy sites or fens as identified in this study, will to a large degree depend on the suitability of local ecological conditions for the occurrence of fen systems.

For the fen peat zones which have been extensively drained, affected by arterial drainage, or land improvements, surveys may not reveal additional fens.

Assuming favourable environmental conditions occur, the potential fen zones identified might be likely to reveal additional fen sites of conservation value, following a detailed fen field survey, and as such, merit further investigation. This might take the form of a desk based air photography reconnaissance to identify those zones that appear to hold wetland systems, selecting the best candidate zones and then undertaking detailed field surveys.

Based on the results of the wetland analysis and the digital fen soils analysis undertaken as part of this study, it is recommended that the following counties should be prioritised as part of a future NPWS Fen Field Survey: Clare, Galway, Kildare, Leitrim, Limerick, Mayo, Offaly, Roscommon and Westmeath (see Table 7.13).

Figure 7.1 (Map sections 1 to 5): Digital fen soil and wetland analysis maps. NPWS Fen Study maps indicating the locations of additional potential fen sites based on the occurrence of fen soils, and the existing network of NHA, SAC and fen sites identified in the current study. Zones where additional fens may be located following field survey are outlined in green.

Map 1 : Index to individual map sections (and legend to map symbols)

Key to counties evaluated on each map section:

Map 2 "North"

- Donegal
- Leitrim (northern part)
- Monaghan

Map 2 "West"

- Sligo
- Galway
- Mayo
- Roscommon
- Clare

Map 3 "East"

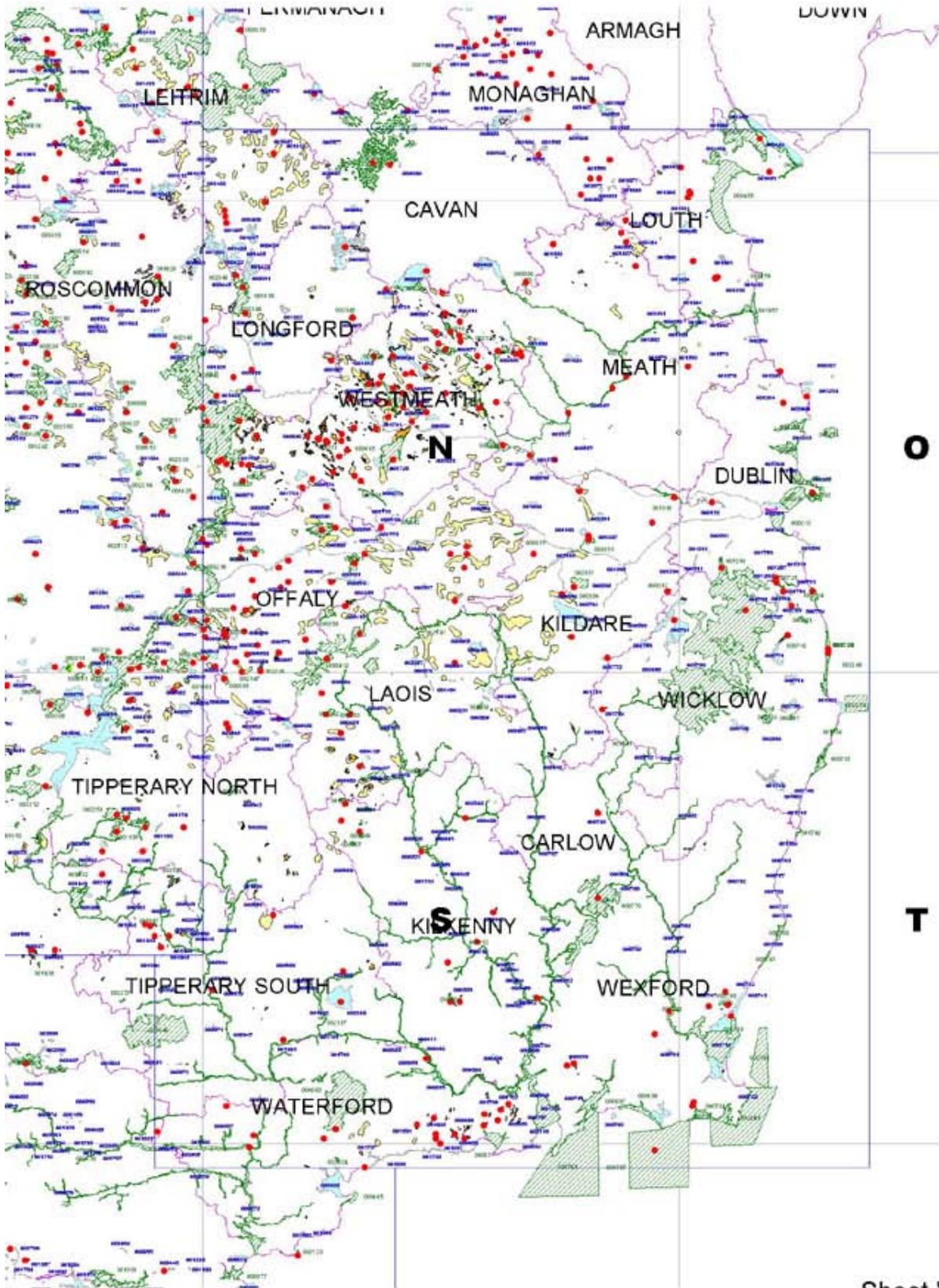
- Leitrim (southern part)
- Cavan
- Louth
- Dublin
- Wicklow
- Meath
- Kildare
- Tipperary
- Laois
- Offaly
- Longford
- Westmeath
- Wexford
- Carlow
- Kilkenny

Map 4 "South"

- Limerick
- Kerry
- Cork
- Waterford

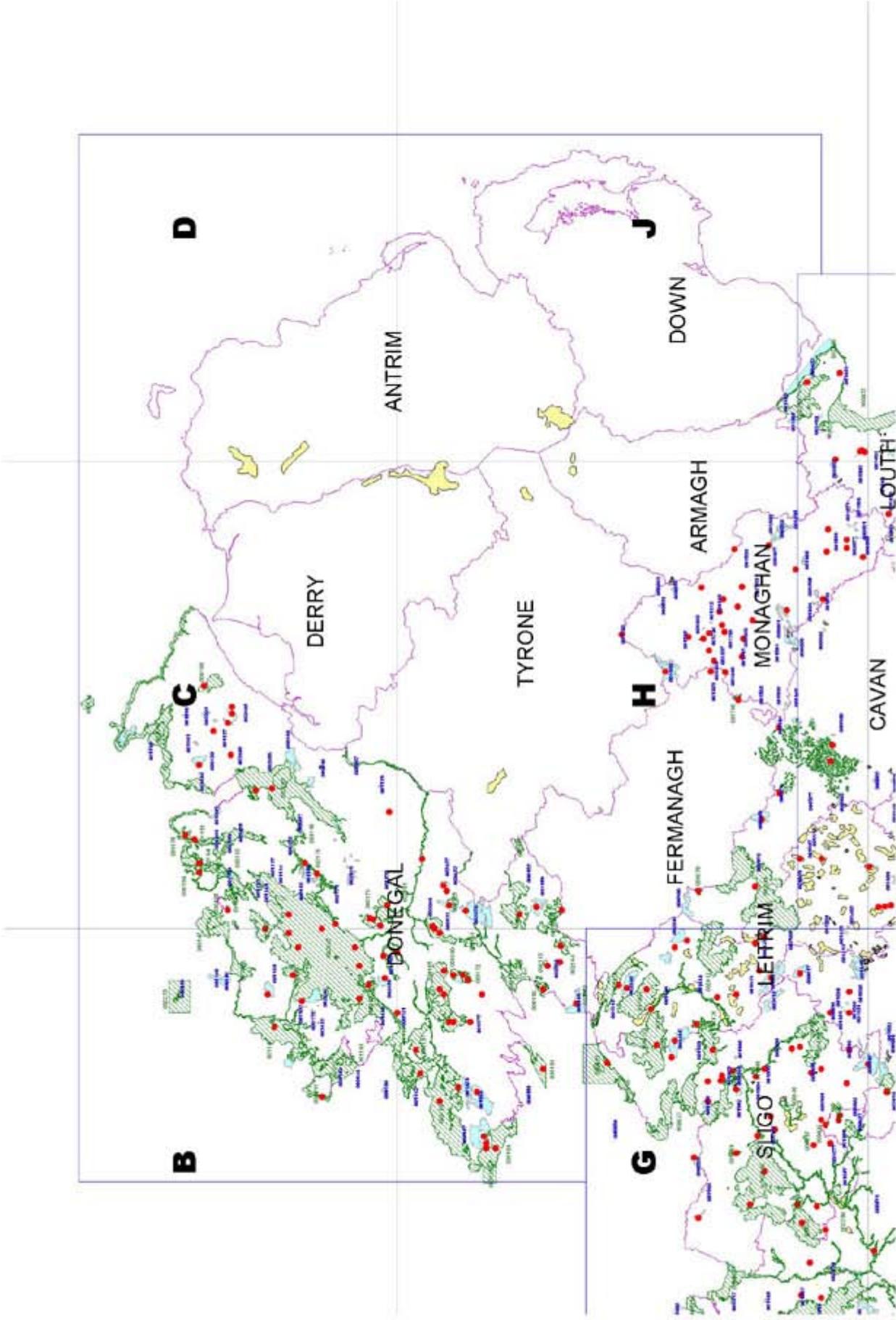
Note:

On the digital version of the NPWS Fen Study report - low resolution maps have been included of the images in Figure 7.1 within the PDF report document. To see high resolution maps (printable at A3 size) consult the folder entitled "Fig 7.1 Map Jpeg layouts" on the CD that accompanies the report.



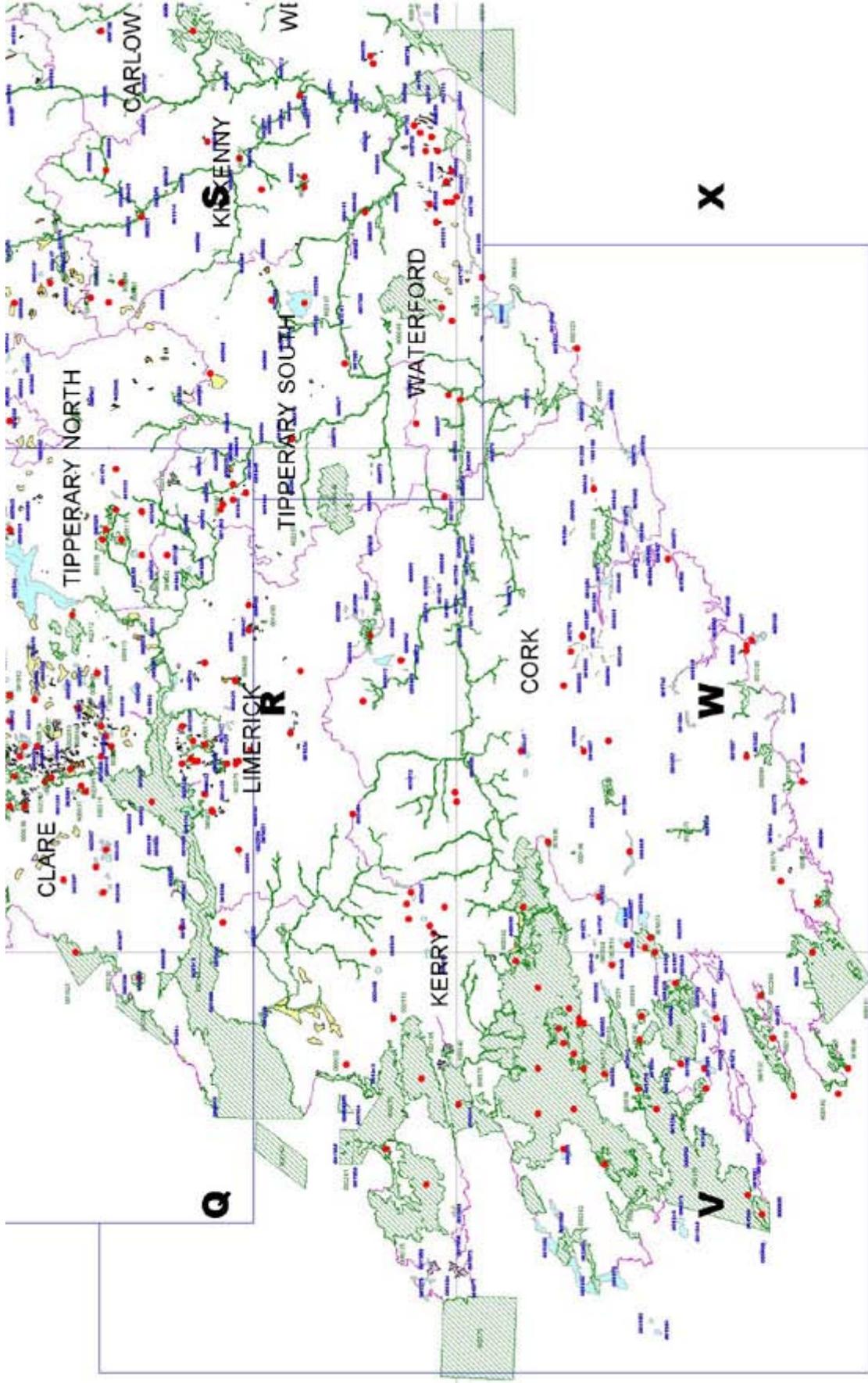
Sheet 'East'





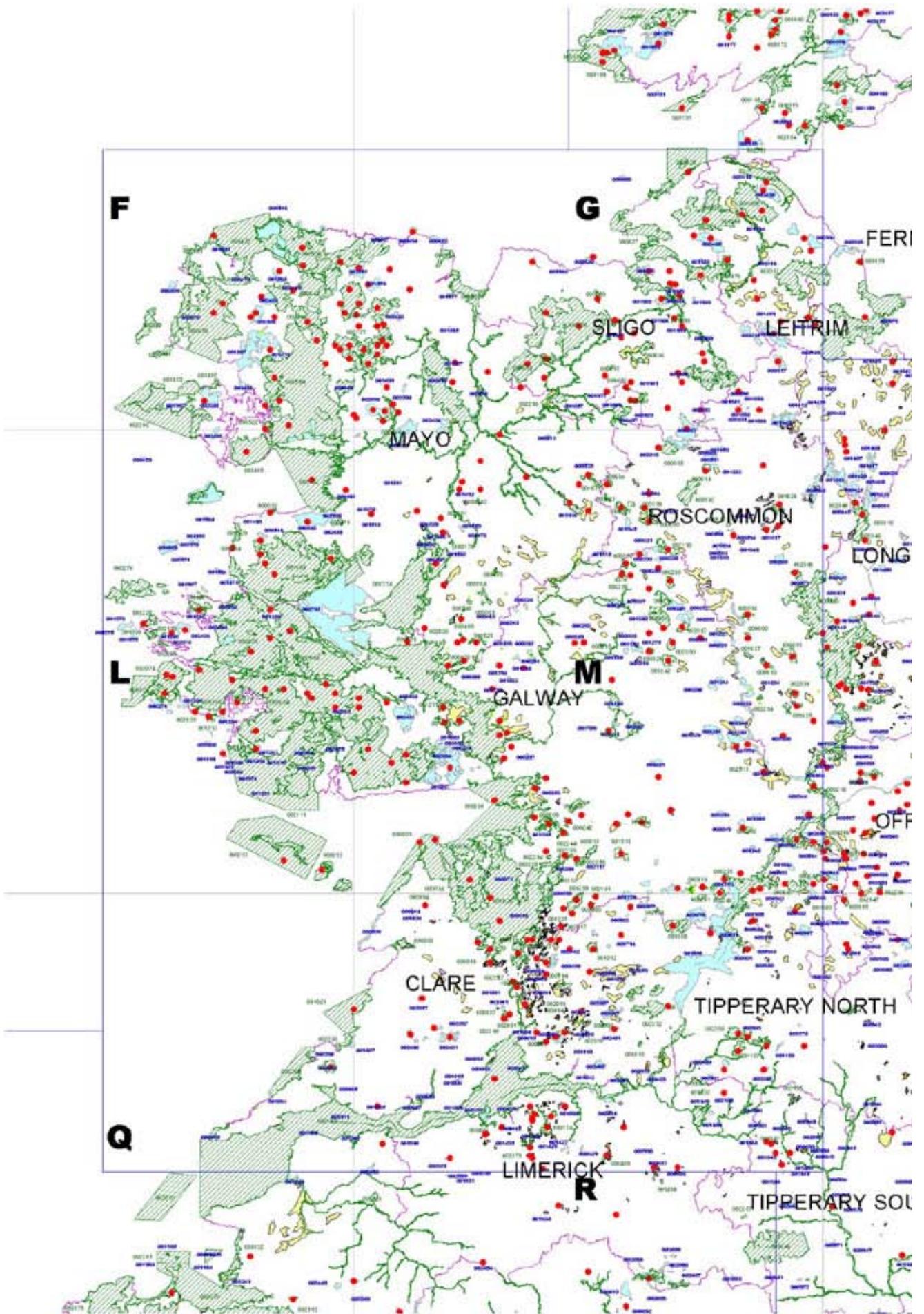
Sheet 'North'





Sheet 'South'





Sheet 'Wes

10 0 10 20 Kilometre
1:750,00

Table 7.13: County recommendations for fen survey as part of a National Fen Field Survey. Comparison of findings from the county wetland analysis and digital fen soils analysis.

| County | National Fen Field Survey Recommendation Priority for Survey High, Moderate, Low | County wetland analysis Probability that additional fens, of all types, will be discovered High, Moderate, Low | Digital fen soils analysis Potential alkaline fen areas identified None, Minor, Moderate, Significant |
|-----------|--|--|---|
| Clare | High | Moderate/High | Significant |
| Cavan | Moderate/High | Moderate/High | Minor |
| Carlow | Low | Low | None |
| Cork | Low/Moderate | Low/Moderate | Minor |
| Donegal | Low/Moderate | Low/Moderate | None |
| Dublin | Low | Low | None |
| Galway | High | High | Significant |
| Kildare | High | Moderate | Significant |
| Kilkenny | Low | Low/Moderate | Minor |
| Kerry | Low | Low | Moderate |
| Longford | Moderate | Moderate | Moderate |
| Louth | Low | Low | Minor |
| Leitrim | High | Moderate/High | Significant |
| Laois | Moderate | Low | Significant |
| Limerick | High | Moderate/High | Moderate |
| Meath | Low | Low | Moderate/Significant |
| Monaghan | Moderate/High | High | Minor |
| Mayo | High | High | Significant |
| Offaly | High | High | Significant |
| Roscommon | High | Moderate/High | Moderate/Significant |
| Sligo | Moderate/High | Moderate/High | Moderate |
| Tipperary | Moderate | Low/Moderate | Significant |
| Westmeath | High | High | Significant |
| Wicklow | Low | Low | None |
| Wexford | Low | Low | None |
| Waterford | Moderate | Moderate | Moderate |

8. Conclusion

8.1 Extent of Irish Fen Resource

At the outset of this project it was estimated that approximately 400 discrete fen sites would be identified during the course of this desk study.

In the final analysis almost double the number of sites (808) have been recorded, making fens one of the most abundant Irish wetland habitat types in terms of numbers- though not in terms of area.

With 22,180 ha of fen in total estimated in the NPWS Fen Study database this figure is similar to that previously reported (IPCC 2001), as far as the total area of fen is concerned.

However, when the extent of the individual fen types is considered, the findings indicate that Cladium fens are rarer than previously estimated, with only 1,486 ha identified in this study in comparison to previous estimates 2,500 ha (O Críodáin 1995). In the case of Alkaline fens these are rarer than previously estimated, with only 6,830 ha identified in this study in comparison to previous estimates 12,000 ha (O Críodáin 1995). Similarly Transition mires are rarer than previously estimated, with only 1,955 ha identified in this study in comparison to previous estimates 6,000 ha (O Críodáin 1995). Only in the case of Petrifying Springs has the area of 36 ha found in this study exceeded the previous estimates of 0.5 ha (O Críodáin 1995).

The most abundant fen type found in the course of this study was Poor fen with an estimated national cover of 11,841 ha. This fen type has a widespread occurrence in blanket bog areas which explains its relative abundance.

In terms of the general extent of the fen resource, when the area of Annex 1 fens (i.e. Alkaline fen, Cladium fen, Transition mire, and Petrifying spring) recorded in this study is considered (which more closely relates to the fen types investigated in previous studies) the total of 10,307 ha is significantly less than the most recent estimate for these fen types in Ireland (estimated at 19,660 ha by IPCC in 2001).

In general, fens are therefore less abundant in terms of their extent in Ireland than previously believed.

8.2 Knowledge of the Irish Fen Resource

From the present NPWS Fen Study it has been possible to assemble a list of sites, which in all probability contain fen vegetation.

It is likely that other sites with fen vegetation do exist outside of these sites which await discovery following a systematic national fen survey.

In relation to the sites which have been identified to date, significant gaps exist in relation to our knowledge of this resource. Specifically, the following information deficits have been identified:

Confusion over the fen type exists on 268 sites (33% of sites identified in the NPWS Fen Study) although some confirmed fen types may already have been identified on these sites. This confusion arises principally due to the fact that fens often occur as a mosaic of different types within a single site, in many cases together with other wetland vegetation types. In addition, where fens have been noted or fleetingly referred to on sites as part of other surveys, the definitions of the fen type recognised varied considerably, making subsequent re-classification on sites difficult, based on the classification scheme adopted

in this study.

There is a significant lack of information over the accurate extent of fen types occurring on 597 sites, making it difficult to assign more than estimated area data to many sites, and limiting our knowledge of the exact extent of the complete fen resource in Ireland.

Where more than one fen type exists on a particular site, confusion over the extent and fen type present is often compounded. This is a common occurrence on many sites considering the nature of fen vegetation and its mosaic distribution on sites.

Accurate area data exists for only 101 sites identified during the NPWS Fen Study.

The national conservation ranking of fen sites has been weak to date, as no overall national comparative study has been undertaken.

In addition, it is likely that many sites with a high conservation value, which have come to light recently, or where information is incomplete, have been overlooked or omitted when drawing up lists of the best sites for conservation within the NHA or SAC network nationally.

From the examination of areas where potential fens are likely to be discovered a number of counties have been identified where survey work is likely to reveal additional fen sites. These are counties: Clare, Galway, Kildare, Leitrim, Limerick, Mayo, Offaly, Roscommon and Westmeath. These counties should be prioritised for future detailed fen field surveys.

The situation, in relation to our complete knowledge of the fen resource in Ireland, will only be improved when a systematic national fen survey, where classification of fen type follows strict criteria; where extent of fen type(s) is accurately mapped; and where potential areas suitable for the discovery of additional fen sites are surveyed; and site ranked and designated for conservation, is undertaken.

9. Recommendations for a future Irish fen field survey

From the results of the NPWS Fen study it is apparent that a National Fen Field Survey is required to obtain a better understanding of the fen resource present in Ireland.

Some 268 fen sites (33%) have been identified in the NPWS Fen Study database which require investigation to address anomalies over the fen types present on these sites and their nature conservation value.

Our current knowledge on the extent of fen habitats on 102 fen sites (13%) identified in the NPWS Fen Study is completely lacking.

No accurate data on the extent of fen habitats exists on an additional 600 fen sites (75%) within the present NPWS Fen Study.

It is likely that the best fen sites may not have been proposed as SACs to date, due principally to the lack of more detailed information on the Irish fen resource at the time the SAC list of sites was compiled by NPWS as part of the Natura 2000 process.

A National Fen Survey, designed to provide accurate fen data on sites and the ranking of sites on a national scale, would allow the most conservation worthy sites to be identified which could then be proposed as fen SAC under one of the four Annex 1 fen habitat types found in Ireland.

Such a project might not add significantly to the fen resource protected as SAC at present, as many additional fen sites recorded in this study already occur within the SAC and cSAC network (designated for other habitats or species), however, it would ensure that the best examples of recognised fen habitats were put forward as fen designated SACs under the Natura 2000 network.

With such a significant number of sites requiring some level of survey, based on the evaluation conducted in this NPWS Fen Study, an extensive National Fen Survey is needed, which will require significant resources if it is to be completed within a realistic time frame.

A National Fen Survey should aim to provide the following information on the fens being surveyed:

- ◊ A detailed site description highlighting the wetland values of each site;
- ◊ A detailed description of the fen vegetation type(s) present on each site (and classification in regard to the fen types identified in the NPWS Fen Study or whatever scheme is adopted in the future);
- ◊ A description of other non-fen wetland types found on each site (in particular reedbeds, marsh, swamp and tall sedge communities as defined by Fossitt);
- ◊ Detailed mapping and measurement of the extent of each of the fen type(s) and other wetland communities classified within each site;
- ◊ Substrate analysis and depth measurements on each site;
- ◊ pH and conductivity analysis on each sites;
- ◊ Identification of water source(s), the location of springs, and natural and man-made abstraction/drainage sources;
- ◊ Mapping of general site boundaries of the overall site to ensure conservation of a hydrologically intact unit;
- ◊ Measurement of total conservation site area;
- ◊ Threats to the conservation and future protection of the site; to include restoration suggestions and management priorities and needs;
- ◊ Evaluation of each site on a national scale and ranking of each site in terms of its suitability and priority for designation within the NHA and/or SAC process;
- ◊ Completion of a standard NHA recording card for each site.

10. Bibliography

- Akeroyd, J.R. & Curtis, T.G.F., 1980, Some observations on the occurrence of machair in western Ireland, *Bull. Ir. Biogeog. Soc.*, 4, 1-12.
- Anonymous, 1994, Use of Corine biotopes data base for the Implementation of the Directive on the conservation of the natural habitats of wild fauna and flora (92/43/EEC). List of Corine sites for which habitats, listed under Annex 1 of the Habitats Directive, have been reported. , Habitats Committee, European Commission, Volume 1.
- Anonymous, 1979, *The Atlas of Ireland*, Royal Irish Academy, Dublin.
- Anonymous, 1981, National Heritage Inventory. Areas of Scientific Interest in Ireland, An Foras Forbartha, Dublin, pp. 166.
- Anonymous, 1982, A National Programme to Protect Outstanding Irish Peatlands. The National Peatland Conservation Committee Site List 1982 , National Peatland Conservation Committee, Dublin.
- Anonymous, 1986, Irish Peatland Conservation Council Action Plan 1986-1988, Irish Peatland Conservation Council, Dublin, pp. 56.
- Anonymous, 1989, The IPCC Action Plan 1989-1992, Irish Peatland Conservation Council, Dublin, pp. 54.
- Anonymous, 1991, Corine Biotopes Manual. Habitats of the European Community. A method to identify and describe consistently sites of major importance for nature conservation. Data Specifications - Part 2. , Commission of the European Communities. EUR 12587/3 EN
- Anonymous, 1992, The Irish Peatland Conservation Council Policy Statement and Action Plan 1992-1997, Irish Peatland Conservation Council, Dublin, pp. 100.
- Anonymous, 2003, Cutaway Bog Rehabilitation. A document to detail the rehabilitation work and aspects of decommissioning of the Oweninny Works in compliance with Condition 10 of IPC license ref. no. 505, and incorporating rehabilitation following development of the Oweninny wind farm, Bord na Mona Internal Report, pp. 5.
- Anonymous, 2005, Management Plan for the Killarney National Park 2005-2009, National Parks & Wildlife Service, Dublin. pp. 158.
- Anonymous, 2005, Management Plan for the Wicklow National Park 2005-2009, National Parks & Wildlife Service, Dublin. pp. 99.
- Anonymous, 2005, Westmeath Peatland Study 2005, Internal Report, Natura Environmental Consultants.
- Anonymous, 2006, Irish Peatland Conservation Council - Peatland Site Database, Irish Peatland Conservation Council, Ireland.
- Anonymous, 2006, Owenduff/Nephrin cSAC & SPA National Parks & Wildlife Service Conservation Plan for 2006-2011, National Parks & Wildlife Service, Dublin. pp. 90.
- Aukema, R. & Scherrenburg, M., 1998, Clochar na gCon survey & sustainable development plan, Internal Report, Irish Peatland Conservation Council, Dublin.
- Barron, S., 2006, County Monaghan Wetland Survey, Internal Report, Monaghan County

Council.

- Bassett, J.A. & Curtis, T.G.F. , 1985, The nature and occurrence of sand dune machair in Ireland, Proceedings of the Royal Irish Academy, 85B, 1-20.
- Bassett, J.A., 1983, Report on the Conservation of Irish Coastal Sites. Machair in Ireland, Unpublished Report . Wildlife Service. Dublin.
- Bellamy, D., 1986, The Wild Boglands, Country House, Dublin.
- Bleasdale, A. & Conaghan, J., 1995, Flushes and Springs in the Connemara Hills and uplands, Co. Galway, Ireland., Bulletin of the British Ecological Society, 24, 28-35.
- Bleasdale, A.J., 1995, The vegetation and ecology of the Connemara Uplands, with particular reference to sheep grazing, Ph.D. Thesis, National University of Ireland, Galway.
- Bond, K.G.M., 1991, A preliminary survey of the Lepidoptera of Pollardstown Fen, Co. Kildare, including a record of *Cosmopterix lienigiella* (Lieng and Zeller 1939) (*Cosmopterigidae*), a species new to Ireland, Bull. Ir. Biogeog. Soc., 14, 24-47.
- Cabot, D., 1999, Ireland. A Natural History, Harper Collins Publishers, London.
- CEC, 1979, Council Directive of 2 April 1979 on the conservation of wild birds (79/409/EEC), Official Journal of the European Communities, No. L103/1, 25 April 1979.
- CEC, 1992, Council Directive of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (92/43/EEC), Official Journal of the European Communities No. L 206/35, 22 July 1992.
- Conaghan, J., 1995, The ecology of *Eriophorum gracile* and *Eriophorum latifolium* in Ireland, Ph.D. Thesis, National University of Ireland, Galway.
- Conaghan, J., 2000, An assessment of the conservation value of a blanket bog landscape to the west of Galway city, Internal report, The Heritage Council, pp. 83.
- Conaghan, J., 2000, The distribution, ecology and conservation of blanket bog in Ireland, Internal report, National Parks and Wildlife Service, Dublin.
- Conaghan, J., 2006, A baseline vegetation survey of a blanket bog restoration site at Derry, Co. Mayo, Internal Report, Coillte Teoranta.
- Connolly, J., Holden, N.M. & Ward, S., 2004, A rules-based GIS methodology for examining the extent of peatlands in Ireland from multi-source data. In: Palanen, J. (ed.) Wise use of Peatlands, International Peat Society, Finland.
- Crawford, I., Bleasdale, A. & Conaghan, J., 1996, Biomar survey of Irish Machair Sites, Internal report, National Parks and Wildlife Service, Dublin.
- Cross, J., 1989, Ireland Former and Present Extent of Raised Bogs (map), Wildlife Service, Office of Public Works, The Stationery Office, Dublin.
- Cross, J., 1990, The Raised Bogs of Ireland, their ecology, status and conservation. Report to the Minister of State at the Department of Finance, The Stationery Office, Dublin.
- Crushell P., 2000, Irish Fen Inventory - A review of the status of fens in Ireland, Irish Peatland Conservation Council, Dublin, pp. 100.

- Crushell P., 2002, SACs IN IRELAND - NGO REVIEW 2002. A report prepared for An Taisce, Birdwatch Ireland, Coastwatch Ireland, Irish Peatland Conservation Council and the Irish Wildlife Trust, Published by Irish Peatland Conservation Council, Dublin.
- Curtis, T & McGough, N., 1981, A Survey of the the Wetlands of the Fergus Catchment and adjoining areas, National Parks & Wildlife Service Internal Report, Dublin.
- Curtis, T. & McGough, N., 1988, The Irish Red Data Book 1 Vascular Plants, Wildlife Service, Stationery Office, Dublin pp. 168.
- Curtis, T., Downes, S., Ni Chathain, B., 2006, The Water Framework Directive, North-South Share Project: Register of Protected Areas. Report on the Ecological Requirements of water dependent habitats and species designated under the Habitats Directive., Internal Report, RPS Consulting Engineers.
- Curtis, T. & Sheehy-Skeffington, M.J., 1988, The Salt Marshes of Ireland: An Inventory and Account of their Geographical Variation Biology and Environment, Proc. Roy. Ir. Acad. 98B No. 2, pp. 87-104.
- Derwin, J. (ed.) et al., 2003/04, Survey and evaluation of blanket bogs for proposal as Natural Heritage Areas, Internal Report, National Parks and Wildlife Service, Dublin.
- Derwin, J. et al., 2002, Raised bog Natural Heritage Areas (NHA) Project, Internal Report, National Parks and Wildlife Service, Dublin.
- Doogue, D., 2005, Ecological Study of the Coastal Habitats in County Fingal. Phase I & II (2003-2005), Internal Report. Fingal County Council.
- Douglas, C. & Grogan, H., 1985, Survey to locate raised bogs of Scientific interest in Counties Galway (E) and Roscommon. Part II, Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Grogan, H., 1986, Survey to locate raised bogs of Scientific interest in Counties Longford, Westmeath and East Mayo (also Counties Cavan, Leitrim, Sligo & Roscommon), Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Grogan, H., 1987, Survey to locate raised bogs of Scientific interest in Connemara, Counties Galway, Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Grogan, H., 1987, Survey to locate raised bogs of Scientific interest in Counties Clare and Kerry, Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Mooney, E., 1984, Survey to locate raised bogs of Scientific interest in Counties Galway (east) and Roscommon. Part I, Internal Report, Wildlife Service, Dublin.
- Douglas, C., 1987, The distribution and ecology of *Sphagnum pulchrum* (Braithw.) Warnst. in Ireland, *Glasra*, 10, 75-81.
- Douglas, C., Dunells, D., Scally, L. & Wyse Jackson, M., 1990, A survey to locate lowland blanket bogs of scientific interest in County Donegal and upland blanket bogs in Counties Cavan, Leitrim and Roscommon, Internal report, National Parks and Wildlife Service, Dublin.
- Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. , 1989a, A survey to locate blanket bogs of scientific interest in County Kerry and County Sligo, Internal report, National Parks and Wildlife Service, Dublin.
- Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. , 1989b, A survey to locate blanket bogs

- of scientific interest in County Galway Part II, Internal report, National Parks and Wildlife Service, Dublin.
- Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. , 1989c, A survey to locate blanket bogs of scientific interest in County Mayo Part II, Internal report, National Parks and Wildlife Service, Dublin.
- Dourcelle, H., 2000, Fenor Bog management plan 2000. , Internal report, Irish Peatland Conservation Council, Dublin.
- Doyle, G.J. & Foss, P.J., 1986, A re-survey of the Clare Island Flora, Ir. Nat. J. 22 85 - 89.
- Doyle, G.J. & Ó Críodáin, C., 2003, Peatlands - fens and bogs. In: Otte, R. (ed.) Irish Wetlands, University College Dublin Press.
- Doyle, G.J., 1982, The vegetation, ecology and productivity of Atlantic blanket bog in Mayo and Galway, western Ireland, Journal of Life Sciences, Royal Dublin Society, 3 pp. 147-164.
- Doyle, G.J., 1984, Pollardstown Fen, In: Jeffrey, D.J. (ed.) Nature Conservation in Ireland, Royal Irish Academy, Dublin. pp. 37-48.
- Dromey, M. & Associates, 1997, An ecological study of Blackwater reservoir and feeder canal, Co. Kildare in relation to a proposed possible raising of the water level. , Internal report, Inland Waterways Association, Kildare Branch.
- Duff, K., 2006, County Waterford Wetlands Survey, Final Report November 2006, Internal Report, Natura Environmental Consultants for Waterford County Council.
- Duff, K., 2006, Westmeath Fen Study 2006, Internal Report, Natura Environmental Consultants.
- Dwyer, R., 2000, Protecting Nature in Ireland: The NGO Special Areas of Conservation Shadow List. A report prepared for An Taisce, Birdwatch Ireland, Coastwatch Ireland, Irish Peatland Conservation Council and the Irish Wildlife Trust, Published by the Irish Peatland Conservation Council, Dublin.
- Edge, R., 2000, Protecting Nature - A baseline survey of a possible candidate SAC, M.Sc. Thesis, Environmental Science, Trinity University College Dublin.
- Emblow, C. , 2003, Development of a baseline ecological data set for selected warm springs in Ireland, Ecoserve Consultancy Services, Dublin.
- Fahy, E., 1975, The biology of a thermal spring at Enfield, Co. Meath, with some observations on other Irish thermal springs, Proceedings of the Royal Irish Academy, 75 B 3, pp. 111-123.
- Farrell, C. & Doyle, G.J., 1998, Rehabilitation of Atlantic blanket bog industrial cutaway at Bellacorrick, North-West Mayo, Ireland. In: O'Leary, G. & Gormley, F. (eds.) Towards a Conservation Strategy for the bogs of Ireland, Irish Peatland Conservation Council, pp. 103-109.
- Farrell, C. & Doyle, G.J., 2003, Rehabilitation of industrial cutaway Atlantic blanket bog in Co. Mayo, North-West Ireland, Wetlands Ecology & Management, Springer, Netherlands, 11: 1-2 pp. 21-35.
- Farrell, C., 2006, Fen Communities within Bord na Móna Bog Areas, Internal Report, Bord na Móna.

- Farrell, C.A., 2004, Post industrial management of a peatland site in County Mayo, West of Ireland: Integrating peatland rehabilitation and sustainable energy production after-uses. In: Palanen, J. (ed.) Wise use of Peatlands, International Peat Society, Finland.
- Feehan, J., 1996, The bogs of Ireland. An introduction to the Natural, Cultural and Industrial Heritage of Irish Peatlands, The Environmental Institute, University College, Dublin.
- Flanagan, P.J. & Toner, P.F., 1975, A preliminary survey of Irish Lakes, An Foras Forbartha, Dublin.
- Fojt, W.J., 1991, Guidelines for fen survey. CSD Note no. 59, Nature Conservancy Council, Peterborough.
- Fojt, W.J., 1995, The nature conservation importance of fens and bogs and the role of restoration. In: Wheeler, B.D., Shaw, S.C., Fojt, W.J. & Robertson, R.A. (eds.) Restoration of temperate wetlands, Wiley & Sons, Chichester.
- Foss, P.J. & McGee, E., 1987, A survey to locate blanket bogs of scientific interest in County Mayo, Internal Report, Wildlife Service Dublin.
- Foss, P.J. & O'Connell C.A. (eds.), 1996, The Irish Peatland Conservation Plan 2000, Irish Peatland Conservation Council, Dublin.
- Foss, P.J. & O'Connell, C.A. (eds.), 1999, A Survey of Cutover & Cutaway Bog Habitats of the Irish Midlands, Irish Peatland Conservation Council, Dublin, pp. 57.
- Foss, P.J. & O'Connell, C.A., 1991, Tullagher Lough & Bog Wetlands Heritage Zone, Unpublished Report, Irish Peatland Conservation Council, Dublin.
- Foss, P.J. & O'Connell, C.A., 1997, Grallagh Bog, Co. Tipperary Survey and Evaluation Report, Internal report, Irish Peatland Conservation Council, Dublin.
- Foss, P.J., 1986, The Distribution, Phytosociology, Autecology and Post-glacial History of *Erica erigena* R. Ross in Ireland. , Ph.D. Thesis, National University of Ireland, Dublin.
- Foss, P.J., 2006, Monaghan Fen Site Reports. Field Excursion by Peter Foss, Colmán Ó Críodáin NPWS, and Shirley Clerkin Heritage Officer Monaghan Co. Co. - 14 to 15 August 2006, Unpublished Report, National Parks and Wildlife Service.
- Foss, P.J., O'Connell C.A. & Crushell P. (eds.), 2001, Bogs and Fens of Ireland Conservation Plan 2005, Irish Peatland Conservation Council, Dublin, pp. 144.
- Fossitt, J., 2000, A Guide to Habitats in Ireland, The Heritage Council, Ireland.
- Giller, P. (ed.), 1998, Studies in Irish Limnology, University College Cork, Cork.
- Goodwillie, R. , 1980, European Peatlands, Council of Europe, Strasbourg.
- Goodwillie, R. , 2003, Vegetation of Turloughs. In: Otte, R. (ed.) Irish Wetlands, University College Dublin, Press.
- Goodwillie, R. & Mooney, E., 1991, Mountain blanket bog survey (draft version), Internal Report, National Parks & Wildlife Service Dublin.
- Hammond R.F., 1979, The Peatlands of Ireland, Soil survey Bulletin No 35, An Foras Talúntais, Dublin.

- Heuff, H., 1984, The vegetation of Irish Lakes, Internal report, Wildlife Service, Dublin.
- Holyoak, G., 2005, Widespread occurrence of *Vertigo geyeri* (Gastropoda: Vertiginidae) in north and west Ireland, *Irish Naturalists Journal*, 28 (4) :141-150.
- Hurley, C, 2005, Bog of Allen Habitat and Heritage Survey, Irish Peatland Conservation Council, pp. 101.
- Ivimey-Cook, R.B. & Proctor, M.C.F., 1966, The plant communities of the Burren, Co. Clare, *Proceedings of the Royal Irish Academy*, B64, pp. 211-301.
- Jermy, A.C., Chater, A.O. & David, R.W., 1982, *Sedges of the British Isles*, Botanical Society of the British Isles, London.
- Kelly, D.L. & Iremonger, S.F., 1997, Irish wetland woods: The plant communities and their ecology, *Biology and Environment: Proceedings of the Royal Irish Academy*, 97B 1 pp. 1-32.
- Kirby, E. N. & B.A. MacGowran, 1979, A Vegetation survey of the proposed National Park area in The Burren, Co. Clare, Unpublished Report to the Office of Public Works. Galway: University College Galway, Dept. of Botany.
- Kirby, E.N., 1981, An Ecological and Phytosociological study of *Corylus avellana* L. in the Burren. , Unpublished PhD thesis No. 985, University College Galway.
- Lockhart, N., 1984, A Report on the wetland vegetation of the Dunkellin and Lavally river catchments (Galway), Internal Report National Parks and Wildlife Service.
- Lockhart, N., 1987a, A method of evaluating wetlands - a case study on the Finn River catchment, County Monaghan, Ireland, *Irish Geography*, 20, pp. 75-81.
- Lockhart, N., 1987b, The occurrence of *Homalothecium nitens* (Hedw.) Robins in Ireland, *Journal of Bryology*, 14, pp. 511-517.
- Lockhart, N., 1988, Further records for *Homalothecium nitens* (Hedw.) Robins in north County Mayo, Ireland, *Journal of Bryology*, 15, pp. 234-235.
- Lockhart, N., 1989, Three new localities for *Saxifraga hirculus* L. in Ireland, *Irish Naturalist's Journal*, 23: pp. 65-69.
- Lockhart, N., 1991, *Phytosociological and Ecological Studies of Lowland Blanket Bog in West Galway and North Mayo*. Ph.D. Thesis, National University of Ireland. pp. 301.
- Lockhart, N., Madden, B., Wolfe-Murphy, S., Wymer, E. and Wyse Jackson, M., 1993, National ASI Survey. Guidelines for ecologists, Unpublished Report. National Parks and Wildlife Service, Dublin.
- Lockhart, N., O'Connell, M., Sheehy-Skeffington, M. & Van Doorslaer, L., 1989, Scraw (Schwingmoor) plant communities at Loch an Chorcail, Carna, Galway, *Irish Naturalist's Journal*, 23: pp. 128-134.
- McKee, A.M., 2000, A phytosociological study and detailed vegetation map of the heathlands of the western Twelve Bens Mountain, Connemara, Ireland, Ph.D. Thesis, National University of Ireland, Galway.
- Mhic Daeid, E.C. , 1979, A phytosociological and ecological study of the vegetation of peatlands and heaths in the Killarney Valley, Ph.D. Thesis, National University of Ireland, Dublin.

- Mooney, E., 1990, A Phytosociological and Palaeoecological Study of the Wetlands of the Lower Corrib Basin, Co. Galway, Ireland. Ph.D. Thesis, National University of Ireland. pp. 141.
- Mooney, E., 1991, Mountain blanket bog survey, Internal report, National Parks and Wildlife Service, Dublin.
- Mooney, E.P. and O'Connell, M., 1990, The phytosociology and ecology of the aquatic and wetland plant communities of the Lower Corrib basin, County Galway, Proceedings of the Royal Irish Academy, 90B, pp. 57-97.
- Ó Críodáin, C. & Doyle, G.J., 1994, An overview of small-sedge vegetation: syntaxonomy and a key to communities belonging to the Scheuzerio-Caricetum nigrae (Nordh. 1936) Tx 1937. , Biology and Environment: Proceedings of the Royal Irish Academy, 94B, pp. 127-144.
- Ó Críodáin, C. & Doyle, G.J., 1997, Schoenetum nigricantis, the Schoenus fen flush vegetation of Ireland, Biology and Environment: Proceedings of the Royal Irish Academy, 97B, 3 pp. 203-218.
- Ó Críodáin, C., 1988, Parvocaricetea in Ireland, Ph.D. Thesis, National University of Ireland.
- O'Connell, C. & Mooney, E., 1983, Survey to locate midland raised bogs of Scientific interest, Internal Report, Wildlife Service, Dublin.
- O'Connell, M., 1979, The development history of Scragh bog, Co. Westmeath and the vegetational history of its hinterland, New Phytologist, 85, pp. 301-319.
- O'Connell, M., 1981, The phytosociology and ecology of Scragh bog, Co. Westmeath, New Phytologist, 87, pp. 139-187.
- O'Connell, M., Ryan, J.B. & Macgowran, B.A., 1984, Wetland Communities in Ireland: a phytosociological review. In: Moore, P.D. (ed.) European Mires, Academic press, London pp. 303-364.
- Otte, R., 2003, Irish Wetlands. Distribution, Ecological Uses and Economic Value, University College Dublin Press, Dublin.
- Poutsma, J., 1999, Fenor bog vegetation survey and management plan, Internal Report, Irish Peatland Conservation Council, Dublin.
- Preston, C.D., Pearman, D.A. & Dines, T.D., 2002, New Atlas of the British and Irish Flora, Oxford University Press, pp. 910.
- Ramao, C., 1996, Interpretation manual of European Union Habitats. Version EUR 15, European Commission, Brussels.
- Ratcliffe, J.D., 1977, A nature conservation review, Cambridge University Press, Cambridge.
- Reil, K., 1996, Bealacoon Bog, Co. Galway Vegetation survey and management plan, Irish Peatland Conservation Council.
- Rieley, J. & Page, S., 1990, Ecology of plant communities. A phytosociological account of the British vegetation, Longman Scientific & Technical, England.
- Rodwell, J.S., et al., 1995, British plant communities. 4. Aquatic communities, swamps and tall-herb fens, Cambridge University Press.

- Scannell, M.J.P. & Synnott, D.M., 1987, Census catalogue of the flora of Ireland, The Stationery Office, Dublin.
- Shaw & Wheeler, 1996, Survey of Fens in Down and Armagh. , Report to the Environment and Heritage Service, Dept. of the Environment, Northern Ireland.
- Sheehy Skeffington, M. & O'Connell C., 1998, Peatlands of Ireland. In: P. Giller (ed.) Studies in Irish Limnology, University College Cork, Cork.
- Sheppard, R., 1993, Ireland's wetland wealth, Irish Wildbird Conservancy, Dublin.
- Tansley, A.G., 1939, The British Islands and their vegetation, Cambridge University Press, Cambridge.
- Van der Borch, E., 2000, Cummeragh River Bog, Co. Kerry Vegetation survey and management plan, Irish Peatland Conservation Council.
- van Heldsdingen, P.J., 1997, The spiders (Araneida) of Pollardstown Fen, Co. Kildare, Ireland, Irish Naturalists Journal, 25, pp. 396-404.
- van Holsteijn, C., 1998, Sheheree Bog Dehydration, Acidification and Eutrophication & the vegetation N/P - ratio as a tool to monitor Eutrophication, Student report, Landscape Ecology, Faculty of Biology, Utrecht University, The Netherlands.
- Wann, J., 1999, Some botanical observations in Co. Limerick (V.C.H.S) for the Atlas 2000 project, Irish Botanical News, No. 9: 32-35.
- Webb D.A., Parnell, J. & Doogue, D., 1996, An Irish Flora, Dundalغان Press Ltd., Dundalk.
- Wheeler, B.D., & Proctor, M.C.F., 2000, Ecological gradients, subdivisions and terminology of north-west European mires, Journal of Ecology 88: pp. 187-203.
- Wheeler, B.D., 1984, British Fens, In: Moore, P.D. (ed.) European Mires, Academic Press, London, pp. 303-364.
- Wilde, A., 1993, Threatened mammals, birds, amphibians and fish in Ireland. Red data book 2: Vertebrates, HMSO, London.
- White, J. & Doyle, G.J., 1982, The Vegetation of Ireland. A Catalogue Raisonne. In: White J. (ed.) Studies on Irish Vegetation, Royal Dublin Society, Dublin. pp. 289-368.
- Wymer, E., 1984, The phytosociology of Irish saltmarsh vegetation, MSc. Thesis. National University of Ireland (UCD).

11. Appendices

Contents

1. Reports & Information sources consulted during the compilation of the NPWS Fen Study Database
2. Groups & Individuals Consulted in the compilation of the NPWS Fen Study Database
3. Groups & Individuals who responded and submitted information to the NPWS Fen Study
4. NPWS Fen Study data sources and import methodology
5. NPWS Fen Study database structure
6. NPWS Fen Study database layouts
7. NPWS Fen Study habitat classification scheme for fens
8. Glossary of terms used
9. Site lists

Appendix 1: Reports & Information sources consulted during the compilation of the NPWS Fen Study Database

1.1 National Parks & Wildlife Service Data Sources

NPWS Natural Heritage Area Sites Database (Pat Warner) created and maintained between 1996-2006 (List of 478 Fen & Flush Sites exported July 2006)
NPWS Special Area of Conservation (cSAC) / Natura 2000 Database
NPWS John Conaghan Blanket Bog Evaluation Database (2000)
NPWS John Derwin Blanket Bog Database & Report (2003-2004)
NPWS Sites Database with Corine classification habitat code overlay
NPWS available information on SAC and NHA (proposed and potential) held in supplementary site descriptions and on Natura 2000 data forms
NPWS Site Synopsis Descriptions for all sites dated 28 July 2006
NPWS scientific research staff site information in particular NHA and SAC data files provided by Lockhart in August 2006; site designations in the NHAfull 3.9 spreadsheet supplied by Lockhart in August 2006.

1.2 Irish Peatland Conservation Council Data Sources

Crushell P., 2000, Irish Fen Inventory - A review of the status of fens in Ireland, Irish Peatland Conservation Council, Dublin, pp. 100.
Fen information held in the IPCC Peatland Site Database
IPCC unpublished documentation held on specific fen sites
Hurley C. information on recently discovered fen sites dated 12.7.2006

1.3 Published accounts/reports on specific sites with fen habitats

Anonymous, 1994, Use of Corine biotopes data base for the Implementation of the Directive on the conservation of the natural habitats of wild fauna and flora (92/43/EEC). List of Corine sites for which habitats, listed under Annex 1 of the Habitats Directive, have been reported. , Habitats Committee, European Commission, Volume 1.
Anonymous, 1981, National Heritage Inventory. Areas of Scientific Interest in Ireland, An Foras Forbartha, Dublin, pp. 166.
Anonymous, 1986, Irish Peatland Conservation Council Action Plan 1986-1988, Irish Peatland Conservation Council, Dublin, pp. 56.
Anonymous, 1989, The IPCC Action Plan 1989-1992, Irish Peatland Conservation Council, Dublin, pp. 54.
Anonymous, 1992, The Irish Peatland Conservation Council Policy Statement and Action Plan 1992-1997, Irish Peatland Conservation Council, Dublin, pp. 100.
Anonymous, 2003, Cutaway Bog Rehabilitation. A document to detail the rehabilitation work and aspects of decommissioning of the Oweninny Works in compliance with Condition 10 of IPC license ref. no. 505, and incorporating rehabilitation following development of the Oweninny wind farm, Bord na Mona Internal Report, pp. 5.
Anonymous, 2005, Management Plan for the Killarney National Park 2005-2009, National Parks & Wildlife Service, Dublin. pp. 158.
Anonymous, 2005, Management Plan for the Wicklow National Park 2005-2009, National Parks & Wildlife Service, Dublin. pp. 99.
Anonymous, 2005, Westmeath Peatland Study 2005, Internal Report, Natura Environmental Consultants.
Anonymous, 2006, Irish Peatland Conservation Council - Peatland Site Database, Irish

- Peatland Conservation Council, Ireland.
- Anonymous, 2006, Owenduff/Nephrin cSAC & SPA National Parks & Wildlife Service Conservation Plan for 2006-2011, National Parks & Wildlife Service, Dublin. pp. 90.
- Aukema, R. & Scherrenburg, M., 1998, Clochar na gCon survey & sustainable development plan, Internal Report, Irish Peatland Conservation Council, Dublin.
- Barron, S., 2006, County Monaghan Wetland Survey, Internal Report, Monaghan County Council.
- Bassett, J.A., 1983, Report on the Conservation of Irish Coastal Sites. Machair in Ireland, Unpublished Report . Wildlife Service. Dublin.
- Bleasdale, A. & Conaghan, J., 1995, Flushes and Springs in the Connemara Hills and uplands, Co. Galway, Ireland., Bulletin of the British Ecological Society, 24, 28-35.
- Bond, K.G.M., 1991, A preliminary survey of the Lepidoptera of Pollardstown Fen, Co. Kildare, including a record of *Cosmopterix lienigiella* (Lieng and Zeller 1939) (*Cosmopterigidae*), a species new to Ireland, Bull. Ir. Biogeog. Soc., 14, 24-47.
- Conaghan, J., 1995, The ecology of *Eriophorum gracile* and *Eriophorum latifolium* in Ireland, Ph.D. Thesis, National University of Ireland, Galway.
- Conaghan, J., 2000, The distribution, ecology and conservation of blanket bog in Ireland, Internal report, National Parks and Wildlife Service, Dublin.
- Conaghan, J., 2006, A baseline vegetation survey of a blanket bog restoration site at Derry, Co. Mayo, Internal Report, Coillte Teoranta.
- Crushell P., 2000, Irish Fen Inventory - A review of the status of fens in Ireland, Irish Peatland Conservation Council, Dublin, pp. 100.
- Crushell P., 2002, SACs IN IRELAND - NGO REVIEW 2002. A report prepared for An Taisce, Birdwatch Ireland, Coastwatch Ireland, Irish Peatland Conservation Council and the Irish Wildlife Trust, Published by Irish Peatland Conservation Council, Dublin.
- Curtis, T & McGough, N., 1981, A Survey of the the Wetlands of the Fergus Catchment and adjoining areas, National Parks & Wildlife Service Internal Report, Dublin.
- Curtis, T., Downes, S., Ni Chathain, B., 2006, The Water Framework Directive, North-South Share Project: Register of Protected Areas. Report on the Ecological Requirements of water dependent habitats and species designated under the Habitats Directive., Internal Report, RPS Consulting Engineers.
- Derwin, J. (ed.) et al., 2003/04, Survey and evaluation of blanket bogs for proposal as Natural Heritage Areas, Internal Report, National Parks and Wildlife Service, Dublin.
- Doogue, D., 2005, Ecological Study of the Coastal Habitats in County Fingal. Phase I & II (2003-2005), Internal Report. Fingal County Council.
- Douglas, C. & Grogan, H., 1985, Survey to locate raised bogs of Scientific interest in Counties Galway (E) and Roscommon. Part II, Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Grogan, H., 1986, Survey to locate raised bogs of Scientific interest in Counties Longford, Westmeath and East Mayo (also Counties Cavan, Leitrim, Sligo & Roscommon), Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Grogan, H., 1987, Survey to locate raised bogs of Scientific interest in Connemara, Counties Galway, Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Grogan, H., 1987, Survey to locate raised bogs of Scientific interest in Counties Clare and Kerry, Internal Report, Wildlife Service, Dublin.
- Douglas, C. & Mooney, E., 1984, Survey to locate raised bogs of Scientific interest in Counties Galway (east) and Roscommon. Part I, Internal Report, Wildlife Service, Dublin.
- Douglas, C., Dunells, D., Scally, L. & Wyse Jackson, M., 1990, A survey to locate lowland blanket bogs of scientific interest in County Donegal and upland blanket bogs in Counties Cavan, Leitrim and Roscommon, Internal report, National Parks and Wildlife Service, Dublin.
- Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. , 1989a, A survey to locate blanket bogs of scientific interest in County Kerry and County Sligo, Internal report, National Parks and Wildlife Service, Dublin.

- Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. , 1989b, A survey to locate blanket bogs of scientific interest in County Galway Part II, Internal report, National Parks and Wildlife Service, Dublin.
- Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. , 1989c, A survey to locate blanket bogs of scientific interest in County Mayo Part II, Internal report, National Parks and Wildlife Service, Dublin.
- Dourcelle, H., 2000, Fenor Bog management plan 2000. , Internal report, Irish Peatland Conservation Council, Dublin.
- Doyle, G.J., 1982, The vegetation, ecology and productivity of Atlantic blanket bog in Mayo and Galway, western Ireland, *Journal of Life Sciences*, Royal Dublin Society, 3 pp. 147-164.
- Doyle, G.J., 1984, Pollardstown Fen, In: Jeffrey, D.J. (ed.) *Nature Conservation in Ireland*, Royal Irish Academy, Dublin. pp. 37-48.
- Dromey, M. & Associates, 1997, An ecological study of Blackwater reservoir and feeder canal, Co. Kildare in relation to a proposed possible raising of the water level. , Internal report, Inland Waterways Association, Kildare Branch.
- Duff, K., 2006, County Waterford Wetlands Survey, Final Report November 2006, Internal Report, Natura Environmental Consultants for Waterford County Council.
- Duff, K., 2006, Westmeath Fen Study 2006, Internal Report, Natura Environmental Consultants.
- Edge, R., 2000, Protecting Nature - A baseline survey of a possible candidate SAC, M.Sc. Thesis, Environmental Science, Trinity University College Dublin.
- Emblow, C. , 2003, Development of a baseline ecological data set for selected warm springs in Ireland, Ecoserve Consultancy Services, Dublin.
- Fahy, E., 1975, The biology of a thermal spring at Enfield, Co. Meath, with some observations on other Irish thermal springs, *Proceedings of the Royal Irish Academy*, 75 B 3, pp. 111-123.
- Farrell, C., 2006, Fen Communities within Bord na Móna Bog Areas, Internal Report, Bord na Móna.
- Flanagan, P.J. & Toner, P.F., 1975, A preliminary survey of Irish Lakes, An Foras Forbartha, Dublin.
- Foss, P.J. & McGee, E., 1987, A survey to locate blanket bogs of scientific interest in County Mayo, Internal Report, Wildlife Service Dublin.
- Foss, P.J. & O'Connell C.A. (eds.), 1996, *The Irish Peatland Conservation Plan 2000*, Irish Peatland Conservation Council, Dublin.
- Foss, P.J. & O'Connell, C.A. (eds.), 1999, *A Survey of Cutover & Cutaway Bog Habitats of the Irish Midlands*, Irish Peatland Conservation Council, Dublin, pp. 57.
- Foss, P.J. & O'Connell, C.A., 1991, Tullagher Lough & Bog Wetlands Heritage Zone, Unpublished Report, Irish Peatland Conservation Council, Dublin.
- Foss, P.J. & O'Connell, C.A., 1997, Grallagh Bog, Co. Tipperary Survey and Evaluation Report, Internal report, Irish Peatland Conservation Council, Dublin.
- Foss, P.J., 1986, The Distribution, Phytosociology, Autecology and Post-glacial History of *Erica erigena* R. Ross in Ireland. , Ph.D. Thesis, National University of Ireland, Dublin.
- Foss, P.J., 2006, Monaghan Fen Site Reports. Field Excursion by Peter Foss, Colmán Ó Críodáin NPWS, and Shirley Clerkin Heritage Officer Monaghan Co. Co. - 14 to 15 August 2006, Unpublished Report, National Parks and Wildlife Service.
- Foss, P.J., O'Connell C.A. & Crushell P. (eds.), 2001, *Bogs and Fens of Ireland Conservation Plan 2005*, Irish Peatland Conservation Council, Dublin, pp. 144.
- Goodwillie, R. & Mooney, E., 1991, Mountain blanket bog survey (draft version), Internal Report, National Parks & Wildlife Service Dublin.
- Hammond R.F., 1979, *The Peatlands of Ireland*, Soil survey Bulletin No 35, An Foras Talúntais, Dublin.
- Heuff, H., 1984, The vegetation of Irish Lakes, Internal report, Wildlife Service, Dublin.
- Holyoak, G., 2005, Widespread occurrence of *Vertigo geyeri* (Gastropoda: Vertiginidae) in north and west Ireland, *Irish Naturalists Journal*, 28 (4) :141-150.
- Hurley, C., 2005, Bog of Allen Habitat and Heritage Survey, Irish Peatland Conservation Council, pp. 101.
- Lockhart, N., 1984, A Report on the wetland vegetation of the Dunkellin and Lavally river

- catchments (Galway), Internal Report National Parks and Wildlife Service.
- Lockhart, N., 1987a, A method of evaluating wetlands - a case study on the Finn River catchment, County Monaghan, Ireland, *Irish Geography*, 20, pp. 75-81.
- Lockhart, N., 1987b, The occurrence of *Homalothecium nitens* (Hedw.) Robins in Ireland, *Journal of Bryology*, 14, pp. 511-517.
- Lockhart, N., 1988, Further records for *Homalothecium nitens* (Hedw.) Robins in north County Mayo, Ireland, *Journal of Bryology*, 15, pp. 234-235.
- Lockhart, N., 1989, Three new localities for *Saxifraga hirculus* L. in Ireland, *Irish Naturalist's Journal*, 23: pp. 65-69.
- Lockhart, N., 1991, Phytosociological and Ecological Studies of Lowland Blanket Bog in West Galway and North Mayo. Ph.D. Thesis, National University of Ireland. pp. 301.
- Lockhart, N., O'Connell, M., Sheehy-Skeffington, M. & Van Doorslaer, L., 1989, Scraw (Schwingmoor) plant communities at Loch an Chorcaill, Carna, Galway, *Irish Naturalist's Journal*, 23: pp. 128-134.
- McKee, A.M., 2000, A phytosociological study and detailed vegetation map of the heathlands of the western Twelve Bens Mountain, Connemara, Ireland, Ph.D. Thesis, National University of Ireland, Galway.
- Mhic Daeid, E.C. , 1979, A phytosociological and ecological study of the vegetation of peatlands and heaths in the Killarney Valley, Ph.D. Thesis, National University of Ireland, Dublin.
- Mooney, E., 1990, A Phytosociological and Palaeoecological Study of the Wetlands of the Lower Corrib Basin, Co. Galway, Ireland. Ph.D. Thesis, National University of Ireland. pp. 141.
- Mooney, E., 1991, Mountain blanket bog survey, Internal report, National Parks and Wildlife Service, Dublin.
- Mooney, E.P. and O'Connell, M., 1990, The phytosociology and ecology of the aquatic and wetland plant communities of the Lower Corrib basin, County Galway, *Proceedings of the Royal Irish Academy*, 90B, pp. 57-97.
- O'Connell, C. & Mooney, E., 1983, Survey to locate midland raised bogs of Scientific interest, Internal Report, Wildlife Service, Dublin.
- O'Connell, M., 1981, The phytosociology and ecology of Scragh bog, Co. Westmeath, *New Phytologist*, 87, pp. 139-187.
- Poutsma, J., 1999, Fenor bog vegetation survey and management plan, Internal Report, Irish Peatland Conservation Council, Dublin.
- Reil, K., 1996, Bealacoon Bog, Co. Galway Vegetation survey and management plan, Irish Peatland Conservation Council.
- Shaw & Wheeler, 1996, Survey of Fens in Down and Armagh. , Report to the Environment and Heritage Service, Dept. of the Environment, Northern Ireland.
- Van der Borch, E., 2000, Cummeragh River Bog, Co. Kerry Vegetation survey and management plan, Irish Peatland Conservation Council.
- van Heldsdingen, P.J., 1997, The spiders (Araneida) of Pollardstown Fen, Co. Kildare, Ireland, *Irish Naturalists Journal*, 25, pp. 396-404.
- van Holsteijn, C., 1998, Sheheree Bog Dehydration, Acidification and Eutrophication & the vegetation N/P - ratio as a tool to monitor Eutrophication, Student report, Landscape Ecology, Faculty of Biology, Utrecht University, The Netherlands.
- Wann, J., 1999, Some botanical observations in Co. Limerick (V.C.H.S) for the Atlas 2000 project, *Irish Botanical News*, No. 9: 32-35.
- Whilde, A., 1993, Threatened mammals, birds, amphibians and fish in Ireland. Red data book 2: Vertebrates, HMSO, London.

Appendix 2: Groups and Individuals consulted in the compilation of data for NPWS Fen Study Database

2.1 National Parks & Wildlife Service

Colmán Ó Críodáin, National Parks and Wildlife Service, June-July 2006

Caitriona Douglas, National Parks and Wildlife Service, July 2006

Neil Lockhart, National Parks and Wildlife Service, July 2006

Michael Wyse-Jackson, National Parks and Wildlife Service, July 2006

Eddie Wymer, National Parks and Wildlife Service, August 2006

Gemma Weir, MPSU National Parks and Wildlife Service, August 2006

Naomi Kingston, National Parks and Wildlife Service, August 2006

Deirdre Lynn, National Parks and Wildlife Service, October 2006

Fernando Valverde, National Parks and Wildlife Service, July/October 2006

2.2 Other Groups & Individuals

Shirley Clerkin, Natural Environment Officer, An Taisce, June 2006

Birdwatch Ireland, June 2006

Jim Martin, BEC Consultants, July 2006

Louise Scally, BioChange, July 2006

Catherine Farrell, Bord na Mona, June 2006

Con Breen, BSBI Recorder Westmeath, July 2006

Congella McGuire, Heritage Officer, Clare County Council, June 2006

Karen Dubsy, Coastwatch Ireland, June 2006

Pat Neville, Coillte Teoranta, August 2006

Sharon Casey, Heritage Officer, Cork County Council, June 2006

Tom Gittings, County Nature Trust, Cork, June 2006

Patrick Crushell, University College Cork, June 2006

Joe Gallagher, Heritage Officer, Donegal County Council, June 2006

Professor Gerry Doyle, Botany Department, University College Dublin, June 2006

Chris Emblow, Ecoserve, June 2006

John Conaghan, Enviroscope, July 2006

Robert Edge, June 2006

John Feehan, University College Dublin, July 2006

Gerry Clabby, Heritage Officer, Fingal County Council, June 2006

Marie Mannion, Heritage Officer, Galway County Council, June 2006

Donal Daly, Geological Survey of Ireland, July 2006

Roger Goodwillie, Environmental Consultant, June 2006

Liam Lysaght, The Heritage Council, June 2006

Caroline Hurley, Conservation Officer, Irish Peatland Conservation Council, June 2006

Irish Peatland Conservation Council, June 2006

Declan Doogue, Conservation Officer, Irish Wildlife Trust, June 2006

Una Cosgrave, Heritage Officer, Kerry County Council, June 2006

Bridget Loughlin, Heritage Officer, Kildare County Council, June 2006

Dearbhala Ledwidge, Heritage Officer, Kilkenny County Council, June 2006

Catherine Casey, Heritage Officer, Laois County Council, June 2006

Tom O'Neill, Heritage Officer, Limerick County Council, June 2006

Lisa McDaniel, Heritage Officer, Longford County Council, June 2006

Brendan McSherry, Heritage Officer, Louth County Council, June 2006

Eleanor Mayes, Environmental Consultant, June 2006

Deirdre Cunningham, Heritage Officer, Mayo County Council, June 2006

Loretta Guinan, Heritage Officer, Meath County Council, June 2006

Shirley Clerkin, Heritage Officer, Monaghan County Council, June 2006

Richard Nairn, Natura Environmental Consultants, June 2006

National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs,
Fens and Flushes in Ireland 2007 by Peter Foss

Siobhan Geraghty, Heritage Officer, North Tipperary County Council, June 2006
Catherine O'Connell, Chief Executive, Irish Peatland Conservation Council, June 2006
Michael O'Connell, Botany Department, NUI Galway, June 2006
Amanda Pedlow, Heritage Officer, Offaly County Council, June 2006
Sylvia Reynolds, BSBI Recorder Limerick, July 2006
Cilian Roden, Environmental Consultant, July 2006
Nollaig McKeown, Heritage Officer, Roscommon County Council, June 2006
Micheline Sheehy Skeffington, Botany Department, NUI Galway, June 2006
Ralph Sheppard, Environmental Consultant, June 2006
Siobhan Ryan, Heritage Officer, Sligo County Council, June 2006
Ruth McGrath, Voice, June 2006
Dominic Berridge, Heritage Officer, Waterford County Council, June 2006
Deirdre Burns, Heritage Officer, Wicklow County Council, June 2006
Bernie Guest, Heritage Officer, Westmeath County Council, June 2006

Appendix 3: Groups and Individuals who responded and submitted information to the NPWS Fen Study

3.1 National Parks & Wildlife Service

Caitriona Douglas, National Parks and Wildlife Service, July 2006
Colmán Ó Críodáin, National Parks and Wildlife Service, June-July 2006
Neil Lockhart, National Parks and Wildlife Service, July 2006
Fernando Valverde, National Parks and Wildlife Service, July 2006
Michael Wyse-Jackson, National Parks and Wildlife Service, July 2006
Eddie Wymer, National Parks and Wildlife Service, August 2006
Gemma Weir, MPSU National Parks and Wildlife Service, August 2006
Naomi Kingston, National Parks and Wildlife Service, August 2006
Deirdre Lynn, National Parks and Wildlife Service, October 2006

3.2 Data on sites submitted by:

Catherine Farrell, Bord na Móna, October 2006
Con Breen, BSBI Recorder Westmeath, October 2006
Rodney Daunt, County Nature Trust, Cork, June 2006
Tom Curtis, Environmental Consultant, July 2006
Robert Edge, May & July 2006
Deborah Tiernan, Assistant Biodiversity Officer, Fingal County Council, October 2006
Caroline Hurley, Conservation Officer, Irish Peatland Conservation Council, June 2006
Shirley Markley, Acting Heritage Officer, Longford County Council, October 2006
Shirley Clerkin, Heritage Officer, Monaghan County Council, August/November 2006
Katherine Duff, Natura Environmental Consultants, September/October 2006
Sylvia Reynolds, BSBI Recorder Limerick, October 2006
Bernie Guest, Heritage Officer, Westmeath County Council, June 2006

3.3 Fen Study Respondents:

Louise Scally, BioChange, July 2006
Birdwatch Ireland, July 2006
Catherine Farrell, Bord na Móna, June 2006
Pat Neville, Coillte Teoranta, August 2006
Congella McGuire, Heritage Officer, Clare County Council, July 2006
Rodney Daunt, County Nature Trust, Cork, June 2006
Tom Gittings, County Nature Trust, Cork, June 2006
Patrick Crushell, University College Cork, June 2006
Tom Curtis, Environmental Consultant, July 2006
Robert Edge, May & July 2006
John Conaghan, Enviroscope, July 2006
Gerry Clabby, Heritage Officer, Fingal County Council, June 2006
Deborah Tiernan, Assistant Biodiversity Officer, Fingal County Council, October 2006
Marie Mannion, Heritage Officer, Galway County Council, June 2006
Liam Lysaght, The Heritage Council, June 2006
Caroline Hurley, Conservation Officer, Irish Peatland Conservation Council, June 2006
Una Cosgrave, Heritage Officer, Kerry County Council, July 2006
Bridget Loughlin, Heritage Officer, Kildare County Council, June 2006
Dearbhala Ledwidge, Heritage Officer, Kilkenny County Council, June 2006
Shirley Markley, Acting Heritage Officer, Longford County Council, June 2006
Shirley Clerkin, Heritage Officer, Monaghan County Council, June 2006
Katherine Duff, Natura Environmental Consultants, October 2006
Catherine O'Connell, Chief Executive, Irish Peatland Conservation Council, June 2006
Michael O'Connell, Botany Department, NUI Galway, June 2006

National Parks & Wildlife Service Study of the Extent and Conservation Status of Springs,
Fens and Flushes in Ireland 2007 by Peter Foss

Amanda Pedlow, Heritage Officer, Offaly County Council, June 2006
Sylvia Reynolds, BSBI Recorder Limerick, August 2006
Nollaig McKeown, Heritage Officer, Roscommon County Council, July 2006
Micheline Sheehy-Skeffington, Botany Department, NUI Galway, June 2006
Mary Tubridy and Associates, Dublin, July 2006
Bernie Guest, Heritage Officer, Westmeath County Council, June 2006
Deirdre Burns, Heritage Officer, Wicklow County Council, July 2006
Ruth McGrath, Voice, June 2006

Appendix 4: NPWS Fen Study data sources and import methodology

A variety of data sources were used in the compilation of the list of sites included within the NPWS Fen Study database. The sources that were used are included in Appendix 1.

In the case of one off sites provided by individuals or groups, data was entered directly from the information provided to the NPWS Fen Study database.

The following import methodologies were applied to the import of site information from more extensive electronic data set sources.

4.1 cSAC and pcSAC Data

An electronic list of SAC, cSAC and pcSAC sites with Annex 1 fen habitats was supplied by M. Wyse Jackson in July 2006.

16 sites were listed Transition mire 7140
19 sites were listed Petrifying Spring 7220
17 sites were listed Cladium fen 7210
37 sites were listed Alkaline fen 7230

Allowing for sites with multiple fen types a total of 68 unique sites records were created from this data set and information on same was imported.

The data for the sites provided was imported from a series of Excel spreadsheets.

Imported data included: SAC code number; SAC name; National Grid reference E & N; Latitude and Longitude; Total SAC area; Corine site code; Notes on flora and fauna of note; and Motivation (field containing information from Pat Warner of key habitats and species of note).

Manual data collection: Following data import information on the area of Annex 1 fen habitats present was manually obtained from the Natura 2000 form for each site and supplemented with information contained on the Explanatory Notes sheet to go with the Natura 2000 form.

During the manual data collection process a number of sites were also found to contain additional Annex 1 habitats which were not listed on the Natura form and for which the site was not designated. Information on these fen habitats were also recorded in relation to the relevant site.

Other information recorded where possible included: year of the most recent site survey; reports and surveys on site; rare species information.

4.2 Blanket Bog fen sites from Conaghan (2000) Data

An electronic list of blanket bog sites (prepared by Conaghan 2000) that contained flushes habitats was obtained from C. Douglas in July 2006.

22 sites were listed with a High (greater than 5%) cover of flushes
74 sites were listed with a Moderate (1-5%) cover of flushes

The data for these sites was imported from a series of Excel spreadsheets.

Imported data included: SAC code number; SAC name; Site name from Blanket Bog surveys; National Grid reference; 6 inch map number; Discovery map number; Air photo number; Site area; County; Notes on flora and fauna of note; Authors and Year of blanket bog survey.

Manual data collection: Following data import all sites were listed in the Poor fen category.

Information on the area of poor fen habitat present was manually calculated based on the total site area. In the case of sites with a high and moderate poor fen cover an area of 5% and 2% respectively was calculated.

Further investigations were subsequently made (Lockhart per comm.) to see whether more specific fen habitat type and/or fen area information could be obtained on selected sites. NHA and CORINE site files were also recorded for these sites to obtain additional information.

4.3 IPCC fen sites from Crushell (2000) Data

An electronic list of fen sites without current conservation designation (prepared by Crushell 2000) was supplied by the Irish Peatland Conservation Council in July 2006.

66 sites were listed

One site Pigeonstown was already listed in the NPWS Fen Study database and was not imported from the IPCC list of sites.

The data for these sites was imported from a Filemaker Pro database.

In addition three further sites, not listed in Crushell (2000) were provided by IPCC during the course of this study. Information on these was manually entered into the NPWS Fen Study database.

Imported data included: Site name; National Grid reference; Longitude; Latitude; 6 inch map number; Discovery map number; Air photo number; Site area; County; Notes on flora and fauna of note; IPCC fen classification category; IPCC site description and information on who provided the site record.

Manual data collection: Following data import all sites were assessed and reclassified according to the fen classification system being adopted in the NPWS Fen Study.

As only a total site area was provided by IPCC, and no specific area for fen habitat was provided, information on the area of fen habitat present was manually entered for each of the site records where such data was available. In the case of sites without specific fen habitat areas a guesstimate value was applied based on the site description.

Further information on a number of these sites was obtained from Lockhart, in particular in relation to recent NPWS surveys of the sites; current designation etc.

4.4 Blanket Bog fen sites from Derwin (2003) Data

An electronic list of 91 blanket bog sites (prepared by Derwin et al. 2003) that contained fens and flushes, quaking areas and the four fen habitats listed in Annex 1 of the Habitats Directive was obtained from C. Douglas in July 2006 and screened for additional fen sites.

69 sites were selected for import to the NPWS Fen Study database that contained relevant habitats and that were selected for NHA designation in the Derwin report.

The data for these sites was imported from a series of Excel spreadsheets.

Imported data included: NHA code number; NHA name; Site name from Blanket Bog survey if different; National Grid reference; Site area; Area of fen habitat(s); Survey team and date of the blanket bog survey.

Manual data collection: Following data import all sites were assessed and the habitats present were reclassified according to the system being adopted in the NPWS Fen Study.

4.5 Natural Heritage Area & Special Area of Conservation new NPWS Site Data 2006

An electronic list set was provided by Edwin Wymer and Neil Lockhart on the 18 August 2006. This was the first export of data from the new NPWS database being created by E. Wymer from a series of data sets in existence within NPWS. The new data set held information on NHA and SAC designated sites with Fossitt habitat classification applied to sites. Data on fen and wetland sites was provided in a series of Excel spreadsheet format. In addition to the main fen and wetland site data list a series of supplementary files were provided including the digitised Natura 2000 data sheets and the Fossitt habitat re-classification data sheets.

The raw data set included 3 lists of sites based on the following criteria:
234 sites were listed as containing one or more Annex 1 habitats 7140;
7220;7210;7230 within a given SAC or NHA

800 sites SAC or NHA, were listed as containing one or more Fossitt habitat PF1;PF2;PF3; FP1;FP2; and FS1;FS2;or GM1 (latter 3 categories reed, swamp and marsh were selected to ensure no sites had been overlooked or misclassified)

905 sites SAC or NHA, were listed as containing one or more Fossitt habitat PF1; PF2; PF3; FP; FP2; and FS1; FS2;or GM1 (as above) together with the respective level 2 Fossitt categories FP; PF; FS; GM only. These 4 additional categories were selected to ensure that where the Fossitt assignment team had only been able to classify the vegetation on a site to the higher Fossitt level (e.g. FS a swamp) the site would not be overlooked in the compilation of the fen site list.

Following examination of the data sets above it was decided to:

Use the 905 data set for the purpose of selecting SAC or NHA sites for this project;

The 905 data set was examined and those sites with only FS1; FS2; (swamps) GM and GM1 (marsh) Fossitt habitats were dropped from the data set (see below).

Following this site reduction process the following sites were imported to the NPWS Fen Study database:

121 SAC sites designated for one of the Fossitt fen categories (duplicates with previous SAC list provided by M Wyse-Jackson were not imported);

356 NHA sites designated for one of the Fossitt fen categories;

234 sites designated for one of the Annex 1 fen habitats were imported.

In each case, sites from these lists, which totalled 711 sites, were only added to the NPWS

Fen Study database provided they were not already present or existed as duplicates under different names.

Imported data included (where available): Site code number; Site name; National Grid reference E & N; Latitude and Longitude; Total site area; Designations (partial); Comments on designations; County; Fossitt classification; Corine site code; Survey information; Short site description (data for those fields underlined were available in a web based data set which accompanied the main excel site file).

The list of 426 swamps and marsh sites originally omitted from the fen selection process, was retained and the list was rechecked to ensure no fen sites had been misclassified into reed or marsh categories. Following a review of the site list, and consultation with NPWS staff (O'Criodain, Lockhart, Curtis and Wyse Jackson) a total of 35 sites were reclassified as fens in one of 6 NPWS Fen Study habitat types and added to the NPWS Fen Study database.

Manual data collection:

Following the automatic import of field information from the Wymer data set; the sites listed were cross checked with newer information on designations and site area provided by Lockhart in the NHAfullcontrol form NLv3_8.xls excel file.

Following this final import of sites the Fen Study database list was evaluated and a series of Site Complex Main Records was created for the larger NHA/SAC which contained a series of site sub units.

The reasons for this were two fold: firstly to relate sub units that occurred within one larger SAC or NHA Site Complex; and secondly to ensure that where a sub unit site was only a small part, in terms of area, of a larger site complex the evaluation process of the area of fen within to remaining complex could be undertaken. A total of 47 Site Complex Main site records were created which contained 127 site sub units.

4.6 CORINE overlay on Natural Heritage Area Site Data Set 2006

An electronic list of sites, produced from the old NPWS Database, with a variety of Corine fen types, and with a Corine site designation, was provided by M. Wyse Jackson in July 2006.

The following Corine "fen" categories were selected and site lists exported (detailed description for the habitats listed can be found in the 1991 Corine Biotopes Manual or see Chapter 4 in this report):

| | |
|------------------|---|
| 14 sites: 54 - | Fens, transition mires and springs |
| 19 sites: 533 - | Fen sedge beds |
| 5 sites: 541 - | Springs Montio-Cardaminetea |
| 9 sites: 542 - | Rich fens Caricion davallianae |
| 76 sites: 544 - | Acidic fens |
| 32 sites: 545 - | Transition mires |
| 14 sites: 5331 - | Fen cladium beds |
| 5 sites: 5411 - | Soft water springs Montio-Cardaminetea |
| 4 sites: 5412 - | Hard water springs Cratoneurion (Tufa and calcareous) |
| 15 sites: 5422 - | Brown bog rush fens - not dominated by Schoenus |
| 14 sites: 5421 - | Black bog rush fens |

8 sites were added to the NPWS Fen Study database after examination of these site lists.

4.7 NPWS Fens & Flushes Natural Heritage Area Site Data Set 2006

An electronic list of sites with a Fens & Flushes vegetation category, produced from an older version of the NPWS site database (created by Pat Warner) was provided by M. Wyse Jackson in July 2006. (Habitat description for the Fens & Flushes category is defined in Lockhart et al 1993 and see Chapter 4 in this report).

478 sites: Fens & Flushes category - NPWS Site Database of Pat Warner

This list of sites was screened against sites already in the NPWS Fen Study database at the end of the main data entry process. At that stage 410 sites were already within the NPWS Fen Study database, with the remainder of 77 sites being either bogs (42) or sites with swamp or marsh vegetation (23) while the remainder were woodlands, coastal areas or turloughs.

No additional sites were therefore added to the NPWS Fen Study database from this data set.

Appendix 5: NPWS Fen Study database structure

A variety of data sources were used in the compilation of the list of sites included within the NPWS Fen Study. In order to compile and manage a list of all sites with fen vegetation in Ireland, and the type and area of fen within each, together with other related site and habitat data, data was entered into a series of Filemaker Pro 8 databases (compatible with both Mac and PC computers). Three relational databases hold the following information on sites within the NPWS Study:

- A. The main NPWS Fen Study sites database, contains information on sites, fen types present, area information and related site data (NPWSFENSURVEY.fp7).
- B. A Bibliography database holds reference to fen publications, reports etc. (fenbiblio.fp7).
- C. A Site information database holds records relating sites to particular citation in reports and publications (siteinforecords.fp7).

The main benefit of using a database in a study of this kind, is that it allows uniform recording of a considerable amount of data on each site, rapid selection of sites for a specific criterion or fields, and the calculation of relevant summary information (e.g. areas of a particular fen habitat type(s) in a given county).

The sections below deal with the following database format information:

Section 1 - deals with fields contained in the main NPWS Fen Study sites database holding information directly related to the fen site.

Section 2 - deals with fields contained in the main NPWS Fen Study sites database holding technical database related fields and calculation fields, and is briefer in format.

Section 3 - deals with the relational bibliography database, and the data fields this contains.

Section 4 - deals with the site publications/report record database, and the data fields this contains.

In the description of the main NPWS Fen Study sites database which follows, respective data entry fields (shown in bold lettering) as seen on the main NPWS Fen Study database when accessed in browse mode (used to scroll through records, edit records and create new site records); together with the technical field name within the actual database (shown underlined and in brackets) which is displayed when the database is viewed in layout mode (used when altering field names, sorting records or exporting data, to, for example, Excel spreadsheets). A brief description of the data held within each of the fields is provided.

Fields marked with an astrix below were key fields for which every effort was made to obtain data in the case of each record. Data entry for non astrix fields was dependent on the availability of information.

Within the database these fields are arranged in a series of related layouts, namely:

Title layout - opening or title page of database

Main Layout - includes key Site Details

Habitats Recorded - includes a list of Fen Habitats present or possibly present on each site; using the classification system adopted in this NPWS Fen Study together with various other workers fen classification systems; and other significant non-fen habitats present

NPWS Fen Study Area Information - includes a list of 6 Fen Habitats present or possibly present on each site as adopted by the NPWS Fen Study and the area of each in hectares

Species Information - includes information on rare or noteworthy Flora and Fauna

Summary Published Information/Surveys on site - includes date when site was most recently surveyed, and who undertook the survey; together with a list of publications, reports etc. that include information on the site

Site Evaluation - includes evaluation of the site based a variety of criteria

Data sources various - includes information on the site from this study and other sources including IPCC; NPWS Pat Warner database etc.

These layout can be accessed by clicking the appropriately named button at the top of the Main Layout (and subsequent layouts) database window (see Appendix 6 for appearance of the various layouts within the NPWS Fen Study database).

Within the NPWS Fen Study database fields are colour coded as follows:

- Data fields, when they first appear (and are usually filled when a record is created) are colour coded in pale green;

- Data fields that are repeated in a second or subsequent layout are colour coded in pale blue;

- Data fields that are created from calculations; or automatically created when a site record is formed etc. are colour coded in pink.

A copy of the NPWS Fen Study database can be found on the CD attached to inside back cover of this report. Additional copies of the database are held with NPWS Research section.

5.1 Data fields in the main NPWS Fen Study database holding fen related site information

Main Layout

Query on site (Query on site)

During data entry if issues or problems arose in relation to the site this check box allowed site record to be flagged and re found for further study.

Query details (Query details)

During data entry if issues or problems arose in relation to the site the nature of the problem or missing data item could be highlighted here.

* SAC/NHA Site Name (SAC NHA Site Name)

The name of the fen site where this forms part or all of a Natural Heritage Area or forms part or all of a Special Area of Conservation.

* SAC/NHA Site Code (SAC NHA Site Code)

The site code where fen site where this forms part or all of a Natural Heritage Area or forms part or all of a Special Area of Conservation.

* Total SAC/NHA Site Area (ha) (Recognised Total SAC NHA Site Area)

The total site area in hectares of the Natural Heritage Area or Special Area of Conservation.

* Non SAC/NHA Site Name (Non SAC NHA Site Name)

The name of the fen site where this is not within a NHA or SAC. Or where the fen site forms only a subunit of a NHA complex or forms part of a SAC Complex.

* Total Non SAC/NHA Site Area (Recognised total undesignated area)

Area in hectares of the site when not a NHA or SAC.

* Total SAC/NHA Subunit Area (Recognised total subunit area)

Area in hectares of the site when it formed a subunit within a NHA or SAC Complex.

* Record site type in terms of NPWS Fen Study (Record site type)

A data field to identify the record type in terms of the current survey; namely a unique site; a site which forms a subunit within a larger SAC or NHA (only subunit area is recorded against this record); or a main record for a site complex (where the total complex area is recorded).

Corine Site Code (Corine site code)

Where site is listed under the CORINE system the appropriate site code is recorded.

Old National Grid Reference (National grid reference)

The grid reference of the site is recorded, where this is given in the old format of letter

followed by 4 or 6 digit number.

National Grid Ref E (Nat grid E)

The grid reference of the E co-ordinate of the site is recorded, where this is given in the new format of a 7 digit number.

National Grid Ref N (Nat grid N)

The grid reference of the N co-ordinate of the site is recorded, where this is given in the new format of a 7 digit number.

Longitude (longitude of site)

The longitudinal co-ordinates of the site.

Latitude (latitude of site)

The latitudinal co-ordinates of the site.

6" map no. (six inch map number)

The number(s) of the Ordnance Survey six inch to one mile scale map(s) in which the site is located.

Discovery map no. (discovery map number)

The number(s) of the Ordnance survey 1:50,000 map(s) in which the site is located.

Air photograph no. (air photograph number)

Air photograph number of black and white images taken in the mid 1970's. Scale approximately 1:30,000.

* County (county)

County in which site occurs. Where site straddles a county border (s) all counties are listed.

Location (location irl nirl)

Site located in the Republic of Ireland recorded as such; while site that cross the border into Northern Ireland are marked Nlrl.

* Site Source (site source information)

Details of who proposed the site as one of the 6 fens types being recorded in the NPWS Fen Survey and where appropriate a reference to the study or report where site is recorded.

* Designations (designations)

If the site has or was designated under one of the various conservation initiatives the appropriate designation is recorded.

* Site SAC Designated for fen type(s) (SAC designated fen types)

If the site has been selected as a candidate SAC by the NPWS the appropriate Annex 1 fen habitat type designation is recorded.

Designations Comments (designations comments)

Comments on the site designations with key dates where appropriate is recorded.

Habitats Recorded

* Confirmed fen habitat type(s) (confirmed fen type)

If site was known to contain one (or more) of the 6 fen types being studied during the current survey, the appropriate fen type(s) was recorded in this field.

* Possible fen habitat type(s) (possible fen type)

If site was thought to possibly contain one (or more) of the 6 fen types being studied during the current survey, the appropriate fen type(s) was recorded as present in this field.

Other key habitat(s) within/bordering site (Fossitt habitat types present)

A list of other habitat types present within or bordering the site, based on the classification system of Fossitt was recorded.

Fen habitat type(s) reported by others - Corine fen types (corine fen habitat types)

A list of Corine fen and wetland types present within the site was recorded.

Fen habitat type(s) reported by others - NPWS Fen types (NPWS fen habitat types)

A list of various NPWS fen and wetland types, as proposed by previous workers, and relevant to the current studies fen types, present within the site was recorded.

Fen habitat type(s) reported by others - IPCC fen types (IPCC fen types)

A list of IPCC fen and wetland types, as used by Crushell 2000 present within the site was recorded, where this site was reported in Crushell 2000.

Habitat Information / Area comments (Habitat information comments)

Comments on fen habitat information for the site, and comments on the percentage values used to calculate the area of fen vegetation on each site and the source of this area information.

NPWS Fen Study Area Information

* Area estimation for fen completed (area estimation of fen completed)

Check box field to indicate whether all published information on the site area had been entered in database.

* Calculated total fen area (calculated total fen area based on habitats)

Calculation field that summed the estimated and confirmed area (see below) of all the fen types possibly or definitely present within a site.

* Confirmed: 6 fen type area (confirmed 6 fen type area)

Calculation field that summed the known area of all of the confirmed 6 fen types present within a site record.

* Possible: 6 fen type area (estimated 6 fen type area)

Calculation field that summed the estimated area of all the fen types possible present within a site.

* Confirmed Fen type - Estimated area (ha) (poor fens estimate area) - a separate field for each of the 6 fen types

A separate field for the area of each of the 6 fen types being investigated and confirmed on the site, where the area was an estimate.

* Confirmed Fen type - Accurate area (ha) (poor fens accurate area) - a separate field for each of the 6 fen types

A separate field for the area of each of the 6 fen types being investigated and confirmed on the site, where the area had been measured and was known.

* Confirmed Fen type - sub-total area (ha) (poor fens total area) - a separate field for each of the 6 fen types

A separate field for the cumulative area (estimated area plus estimated area) of each of the 6 fen types being investigated on the site.

* Possible Fen type - Estimated area (ha) (Possible poor fens estimate area) - a separate field for each of the 6 fen types

A separate field for the area of each of the 6 fen types being investigated and possibly present on the site, where the area was an estimate.

Species Information

Noteworthy Flora/Fauna (Species of note)

Presence of either or both noteworthy flora or fauna was recorded.

Flora species of note (flora species of note)

List of noteworthy flora recorded for the site.

Fauna species of note (fauna species of note)

List of noteworthy fauna recorded for the site.

Flora & Fauna comments (flora fauna comments)

Comments on species information for the site.

Summary Published Information/Surveys on site

* Date of last known survey (Date of last known survey)

Date field where date of last survey of site was recorded.

* Survey comments (Survey comments)

Comments on survey information for the site, undertaken for by NPWS and external survey

sources.

Summary of Published Information on site (amalgamated reference; reference number)

List of published information sources which referred to site. Data held in related bibliography database, and indexed to site record number.

Data sources various

NPWS Site Synopsis Description (NPWS Site Synopsis Description)

In selected cases the NPWS site synopsis description for the site was included in this field.

Other group site description/information (Other group site description)

Brief description of site as provided by external sources or from NPWS records.

Pat Warner habitat motivation (Pat Warner habitat motivation)

Series of habitat(s) (code format) used by Pat Warner in NPWS database to explain importance of site.

Pat Warner Species information (Pat Warner species motivation)

Series of species (code format) used by Pat Warner in NPWS database to explain importance of site.

NPWS Region (NPWS region)

The administrative region within NPWS in which the site is located is recorded.

Site Evaluation

* Site Evaluation - Conservation importance of this site for key fen type(s) (conservation importance of site for key fen type)

Once data collection on site was completed the site graded on a on a 3 point scale in relation to its conservation importance based on the fen area recorded; the presence of priority habitat(s) or species.

* Site Evaluation - Accuracy of area information on fen habitats within site (area information on fen site)

Once data collection on site was completed the site graded on a on a 4 point scale in relation to available information on the area of fen vegetation present.

* Site Evaluation - Known survey information on site (known survey information on fen site)

Once data collection on site was completed the site graded on a on a 3 point scale in relation to available knowledge, reports, surveys, etc. on the site.

* Site Evaluation - Need for survey of site (need for field survey)

Once data collection on site was completed the site graded on a on a 3 point scale in

relation to need for a field survey.

5.2 Technical data fields in the NPWS Fen Study database

Modification time stamp: date entered each time a field in fen site record is altered.

Record Number: Unique number created by Filemaker when new site record is added to database.

Acre to hectare conversion: Calculation field that converted area measurements to hectares (uses fields Area in Acres and Area of site calculated).

Output Confirmed fen type: converted field where check boxes for the different confirmed fen types present on site are converted to text string.

Output possible fen type: converted field where check boxes for the different possible fen types present on site are converted to text string.

Output conservation designations: converted field where check boxes for the different site designations are converted to text string.

Output SAC designated fen types: converted field where check boxes for the different SAC designated fen types present on site are converted to text string.

Output county: converted field where check boxes for the different counties are converted to text string.

Summary fields: a series of fields that count the number of sites; and sum fen and other areas.

IPCC database fields: a series of fields from the IPCC sites database where information on IPCC habitat type; ownership status and notes of ownership; site designations and notes on same are recorded.

5.3 Data fields in the Bibliography database

Bibliog Number: Unique number created by Filemaker when new publication record is added to database. This is subsequently used in the main NPWS Fen Study database to relate back to reference in the Bibliography database.

Authors: Author(s) of report, surname and initial format.

Year: Year in which report/publication was published.

Title: Title of report/publication and where relevant title of book this appeared in.

Journal, Publisher, Location, No. Pages: further details of publication.

A series of check boxes indicating whether this reference was cited in the final fen study report; provided information to the study database and or was a NPWS blanket bog or raised bog survey report. These check boxes were subsequently used to generate lists of publication.

5.4 Data fields in the site publications/ report records database

Title: Title of report/publication and where relevant title of book this appeared in.

Site record number: related site record number as in the main NPWS Fen study database which is used to look-up site name and code number.

Citation record number: Unique number created by Filemaker when new record is added to database.

Reference code: related bibliography record number as in the bibliography database which is used to look-up full reference title.

Appendix 6: NPWS Fen Study database layouts

A series of layouts, containing related site data, form the main structure and content of the NPWS Fen Study database. These layout were used when adding site related data to the database. These layouts (indicated by yellow buttons along the top of the Main NPWS Fen Study database layout) and the site information they hold are:

Title layout: Opening title page layout of database displayed when this is opened and FileMaker is launched, with title copyright statement and enter button.

Main Layout: Layout containing basic site details including name, total site area, location data and information on site designations.

Habitats Recorded: Layout containing site details on the fen habitat type(s) present as well as information on other habitat types recorded in previous surveys.

NPWS Fen Study Area Information: Layout containing site details on the extent of the fen habitat type(s) present.

Species Information: Layout containing site details on the occurrence of rare or unusual flora and fauna.

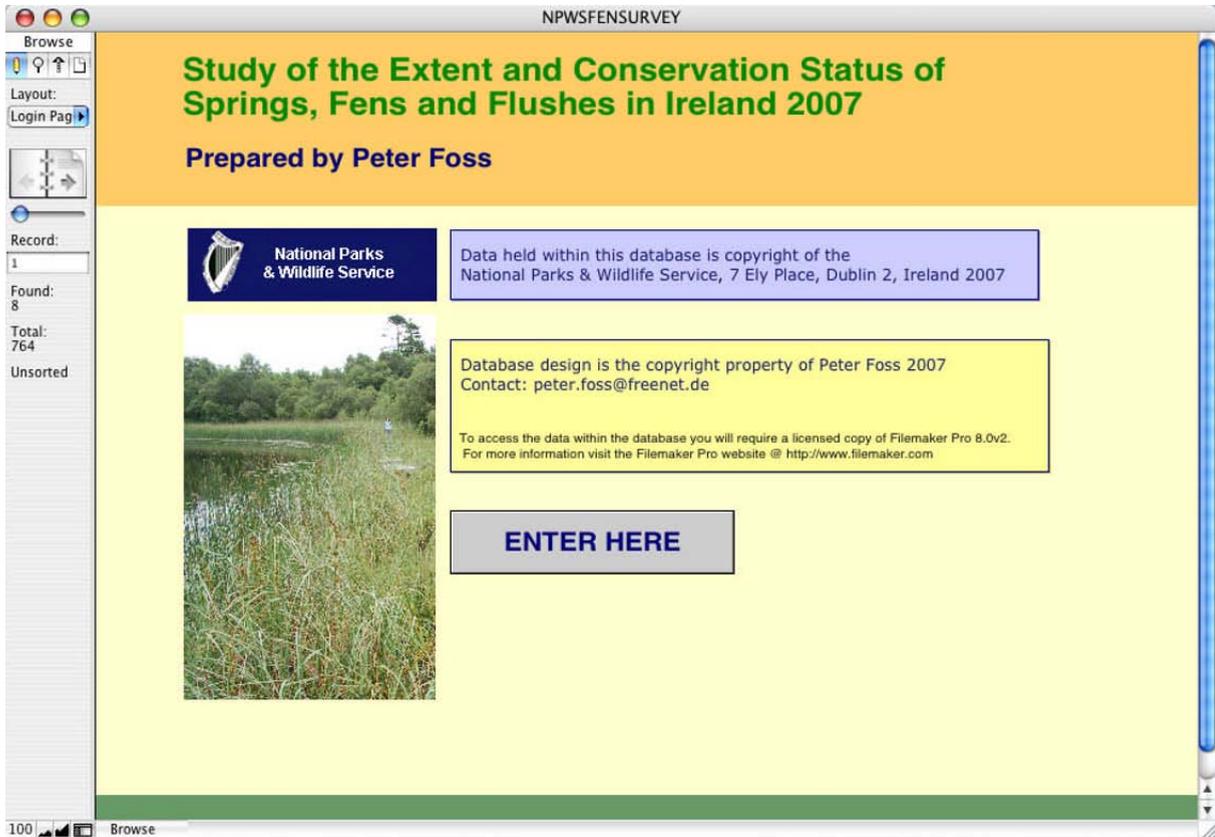
Summary published information/surveys on site: Layout containing site details on site surveys undertaken; most recent survey date; and reference to site in published reports.

Site evaluation: Layout containing site evaluation scheme.

Data sources various: Layout containing site description comments and details from the present study and previous surveys.

The remaining layouts (indicated a a series of non-yellow coloured buttons along the top of the Main NPWS Fen Study database layout) contain data selection (find options) and view or layout options within the NPWS Fen Study database.

Title Layout - NPWS Fen Study Database



Main Data Entry Layout - NPWS Fen Study Database

Survey of the Extent and Conservation Status of Fens in Ireland

Record No. 205 Modification Timestamp 10/30/2006

Main Layout

Habitats Recorded

NPWS Fen Study Area Information

Species Information

Summary Published Info/Surveys on site

Site Evaluation

Add new site record

Add reference to bibliography

Data sources various

Additional Layouts list

Basic Find Command

Various Finds Options

Query on site
 Query on this site

Query Resolved

Site Details

SAC/NHA Site Name MILLTOWN LAKES

SAC/NHA Site Code 002605

Total SAC/NHA Site Area (ha) 120

Non SAC/NHA Site Name(s)
or Subunit name within SAC/NHA Complex

Total Non SAC/NHA Site Area Total SAC/NHA Subunit Area

Record site type in terms of NPWS Fen Study Individual Site Corine Site Code
 Site Complex - Main Record
 Site Complex - Subunit

Old National Grid Reference R 375 540

National Grid Ref E National Grid Ref N

Longitude: W 008 55 30 W Latitude: N 52 38 00 N

6" map no. Discovery map no. 64 Air photograph no.

County

| | | | | |
|----------------|----------------|-----------------------------|--|-----------------------------|
| AM - Antrim | LE - Leitrim | <input type="checkbox"/> AM | <input type="checkbox"/> KK | <input type="checkbox"/> WA |
| AH - Armagh | LI - Limerick | <input type="checkbox"/> AH | <input type="checkbox"/> LA | <input type="checkbox"/> WM |
| CW - Carlow | LF - Longford | <input type="checkbox"/> CW | <input type="checkbox"/> LE | <input type="checkbox"/> WX |
| CV - Cavan | LH - Louth | <input type="checkbox"/> CV | <input checked="" type="checkbox"/> LJ | <input type="checkbox"/> WI |
| CL - Clare | MA - Mayo | <input type="checkbox"/> CL | <input type="checkbox"/> LF | |
| CO - Cork | ME - Meath | <input type="checkbox"/> CO | <input type="checkbox"/> LH | |
| DC - Donegal | MO - Monaghan | <input type="checkbox"/> DG | <input type="checkbox"/> MA | |
| DY - Derry | OF - Offaly | <input type="checkbox"/> DY | <input type="checkbox"/> ME | |
| DW - Down | RO - Roscommon | <input type="checkbox"/> DW | <input type="checkbox"/> MO | |
| DU - Dublin | SL - Sligo | <input type="checkbox"/> DU | <input type="checkbox"/> OF | |
| FH - Fermanagh | TI - Tipperary | <input type="checkbox"/> FH | <input type="checkbox"/> RO | |
| GA - Galway | TE - Tyrone | <input type="checkbox"/> GA | <input type="checkbox"/> SL | |
| KE - Kerry | WA - Waterford | <input type="checkbox"/> KE | <input type="checkbox"/> TI | |
| KD - Kildare | WM - Westmeath | <input type="checkbox"/> KD | <input type="checkbox"/> TE | |
| KK - Kilkenny | WX - Wexford | | | |
| LA - Laois | WI - Wicklow | | | |

Location Rep. Ireland N. Ireland

Site source:
Who recommended site. Full info for Non-SAC/NHA in Data sources various
IPCC list of sites from Crushell Fen Survey 2000
Submission from Geoff Hunt (2000); NL REF439

Query details

Temporary Flag this record

Designations

Designations

Key dates for designations see below

| | | | | | |
|--|--------------------------------|-------------------------------|------------------------------|------------------------------|--|
| <input type="checkbox"/> NHA | <input type="checkbox"/> SAC | <input type="checkbox"/> SPA | <input type="checkbox"/> NP | <input type="checkbox"/> RAM | <input type="checkbox"/> BIO |
| <input type="checkbox"/> pNHA | <input type="checkbox"/> cSAC | <input type="checkbox"/> cSPA | <input type="checkbox"/> BGR | <input type="checkbox"/> ASI | <input type="checkbox"/> COR |
| <input checked="" type="checkbox"/> cNHA | <input type="checkbox"/> pcSAC | <input type="checkbox"/> NNR | <input type="checkbox"/> WHS | <input type="checkbox"/> ESA | <input type="checkbox"/> Undesignated site |

NHA - Natural Heritage Area with legal protection
cNHA - candidate Natural Heritage Area no legal protection
pNHA - proposed Natural Heritage Area as advertised in 1995 no legal protection
SAC - Special Area for Conservation with legal protection
cSAC - candidate Special Area for Conservation open to appeal/transmitted to EU
pcSAC - proposed candidate Special Area for Conservation open to appeal/ not yet transmitted to EU
SPA - Special Protection Area
cSPA - candidate Special Protection Area

NP - National Park with legal protection
WHS - World Heritage Site
NNR - National Nature Reserve with legal protection
BIO - Unesco Biosphere Reserve
RAM - Ramsar Site
ESA - Environmentally Sensitive Area
EDS - Eurodiploma Site
ASI - Area of Scientific Interest
BGR - Berne Convention Biogenetic Reserve
COR - Corine site
Undesignated site - new site obtained during Fen Study Project

Site SAC Designated for fen type(s) Cladium fen 7210 Petrifying Spring 7220
 Transition Mire 7140 Alkaline fen 7230

Designations Comments

Habitats Layout - NPWS Fen Study Database

| Survey of the Extent and Conservation Status of Fens in Ireland | | | | | | Record Number |
|--|--------------------------------------|---|--|--|---------------------------------|---------------|
| Main Layout | Habitats Recorded | NPWS Fen Study Area Information | Species Information | Summary Published Info/Surveys on site | Site Evaluation | |
| | Data sources various | Additional Layouts list | Basic Find Command | Various Finds Options | | |
| Site Details | | | | | | |
| SAC/NHA Site Name | | <input type="text"/> | | | | |
| SAC/NHA Site Code | | <input type="text"/> | | | | |
| Non SAC/NHA Name(s) or Subunit name within SAC/NHA Complex | | <input type="text"/> | | | | |
| National Grid Reference | | <input type="text"/> | | | | |
| NPWS Fen Study Habitat Type(s) Present | | | | | | |
| Confirmed Fen Habitat Type(s) | | | Possible Fen Habitat Type(s) | | | |
| <input type="checkbox"/> Cladium fen 7210/PF1 <input type="checkbox"/> Alkaline fen 7230/PF1 <input type="checkbox"/> Poor fen/PF2 <input type="checkbox"/> Transition Mire 7140/PF3 <input type="checkbox"/> Petrifying Spring 7220/FP1 <input type="checkbox"/> Non calcareous spring/FP2 | | | <input type="checkbox"/> Cladium fen 7210/PF1 <input type="checkbox"/> Alkaline fen 7230/PF1 <input type="checkbox"/> Poor fen/PF2 <input type="checkbox"/> Transition Mire 7140/PF3 <input type="checkbox"/> Petrifying Spring 7220/FP1 <input type="checkbox"/> Non calcareous spring/FP2 | | | |
| Other Key Habitat Type(s) in / bordering site (Fossitt system) | | | | | | |
| <input type="checkbox"/> FP Springs <input type="checkbox"/> FP1 Calcareous springs <input type="checkbox"/> FP2 Non-Calcareous springs <input type="checkbox"/> PF Fens & Flushes <input type="checkbox"/> PF1 Rich fen and flush <input type="checkbox"/> PF2 Poor fen and flush <input type="checkbox"/> PF3 Transition mire & quaking bog <input type="checkbox"/> FS Swamps <input type="checkbox"/> FS1 Reed and large sedge swamps <input type="checkbox"/> FS2 Tall herb swamps <input type="checkbox"/> GM Marsh <input type="checkbox"/> GM1 Marsh <input type="checkbox"/> FL Feshwater <input type="checkbox"/> FL Lakes & Ponds <input type="checkbox"/> FL1 Dystrophic lakes <input type="checkbox"/> FL2 Acid oligotrophic lakes <input type="checkbox"/> FL3 Limestone/marl lakes <input type="checkbox"/> FL4 Mesotrophic lakes <input type="checkbox"/> FL5 Eutrophic lakes <input type="checkbox"/> FL6 Turfoughs <input type="checkbox"/> FL7 Reservoirs <input type="checkbox"/> FL8 Other artificial lakes and ponds <input type="checkbox"/> FW Watercourses <input type="checkbox"/> FW1 Eroding/upland rivers <input type="checkbox"/> FW2 Depositing/lowland rivers <input type="checkbox"/> FW3 Canals <input type="checkbox"/> FW4 Drainage ditches <input type="checkbox"/> G Grassland & Marsh <input type="checkbox"/> GA Improved Grassland <input type="checkbox"/> GA1 Improved agricultural grassland <input type="checkbox"/> GA2 Amenity grassland (improved) <input type="checkbox"/> GS Semi-Natural Grassland <input type="checkbox"/> GS1 Dry calcareous and neutral grassland <input type="checkbox"/> GS2 Dry meadows and grassy verges <input type="checkbox"/> GS3 Dry-humid acid grassland <input type="checkbox"/> GS4 Wet grassland <input type="checkbox"/> H Heath and dense bracken <input type="checkbox"/> HH Heath <input type="checkbox"/> HH1 Dry siliceous heath <input type="checkbox"/> HH2 Dry calcareous heath <input type="checkbox"/> HH3 Wet heath <input type="checkbox"/> HH4 Montane heath <input type="checkbox"/> HD Dense Bracken <input type="checkbox"/> HD1 Dense bracken <input type="checkbox"/> P Peatlands <input type="checkbox"/> PB Bogs <input type="checkbox"/> PB1 Raised bogs <input type="checkbox"/> PB2 Upland blanket bog <input type="checkbox"/> PB3 Lowland blanket bog <input type="checkbox"/> PB4 Cutover bog <input type="checkbox"/> PB5 Eroding blanket bog <input type="checkbox"/> W Woodland and scrub <input type="checkbox"/> WN Semi-natural woodland <input type="checkbox"/> WN1 Oak-birch-holly woodland <input type="checkbox"/> WN2 Oak-ash-hazel woodland <input type="checkbox"/> WN3 Yew woodland <input type="checkbox"/> WN4 Wet pedunculate oak-ash woodland <input type="checkbox"/> WN5 Riparian woodland <input type="checkbox"/> WN6 Wet willow-aider-ash woodland <input type="checkbox"/> WN7 Bog woodland <input type="checkbox"/> WD Highly modified/non-native woodland <input type="checkbox"/> WD1 (Mixed) broadleaved woodland <input type="checkbox"/> WD2 Mixed broadleaved/conifer wd <input type="checkbox"/> WD3 Yew woodland <input type="checkbox"/> WD4 Conifer plantation <input type="checkbox"/> WD5 Scattered trees and parkland <input type="checkbox"/> WS Scrub/transitional woodland <input type="checkbox"/> WS1 Scrub <input type="checkbox"/> WS2 Immature woodland <input type="checkbox"/> WS3 Ornamental/non-native shrub <input type="checkbox"/> WS4 Short rotation coppice <input type="checkbox"/> WS5 Recently-felled woodland <input type="checkbox"/> WL Linear woodland/scrub <input type="checkbox"/> WL1 Hedgerows <input type="checkbox"/> WL2 Treelines <input type="checkbox"/> E Exposed rock & disturbed ground <input type="checkbox"/> ER Exposed Ground <input type="checkbox"/> ER1 Exposed siliceous rock <input type="checkbox"/> ER2 Exposed calcareous rock <input type="checkbox"/> ER3 Siliceous scree and loose rock <input type="checkbox"/> ER4 Calcareous scree and loose rock <input type="checkbox"/> ED Disturbed ground <input type="checkbox"/> ED1 Exposed sand, gravel or till <input type="checkbox"/> ED2 Spoil and bare ground <input type="checkbox"/> ED3 Reclaiming bare ground <input type="checkbox"/> ED4 Active quarries and mines <input type="checkbox"/> ED5 Refuse and other waste <input type="checkbox"/> EU Underground rock and caves <input type="checkbox"/> EU1 Non-marine caves <input type="checkbox"/> EU2 Artificial underground habitats <input type="checkbox"/> B Cultivated & built land <input type="checkbox"/> BC Cultivated land <input type="checkbox"/> BC1 Arable crops <input type="checkbox"/> BC2 Horticultural land <input type="checkbox"/> BC3 Tilled land <input type="checkbox"/> BC4 Flower beds and borders <input type="checkbox"/> BL Built land <input type="checkbox"/> BL1 Stone walls and other stonewc <input type="checkbox"/> BL2 Earth banks <input type="checkbox"/> BL3 Buildings and artificial surfaces <input type="checkbox"/> C Coastland <input type="checkbox"/> CS Sea cliffs & isles <input type="checkbox"/> CS1 Rocky sea cliffs <input type="checkbox"/> CS2 Sea stacks and islets <input type="checkbox"/> CS3 Sedimentary sea cliffs <input type="checkbox"/> CW Brackish water <input type="checkbox"/> CW1 Lagoons and saline lakes <input type="checkbox"/> CW2 Tidal rivers <input type="checkbox"/> CM Salt marshes <input type="checkbox"/> CM1 Lower salt marsh <input type="checkbox"/> CM2 Upper salt marsh <input type="checkbox"/> CB Shingle and gravel banks <input type="checkbox"/> CB1 Shingle and gravel banks <input type="checkbox"/> CD Sand dune systems <input type="checkbox"/> CD1 Embryonic dunes <input type="checkbox"/> CD2 Marram dunes <input type="checkbox"/> CD3 Fixed dunes <input type="checkbox"/> CD4 Dune scrub and woodland <input type="checkbox"/> CDE Dune elastic <input type="checkbox"/> CD6 Machair | | | | | | |
| Fen Habitat Type(s) Reported by others | | | | | | |
| Corine Fen Types | | | | | | |
| <input type="checkbox"/> 533 - Fen sedge beds <input type="checkbox"/> 5331 - Fen cladium beds <input type="checkbox"/> 54 - Fens, transition mires & springs <input type="checkbox"/> 541 - Springs Montio-Cardaminetea <input type="checkbox"/> 5411 - Soft water springs Montio-Cardaminetea <input type="checkbox"/> 5412 - Hard water springs Cratoneurion (Tufa & calcareous) <input type="checkbox"/> 542 - Rich fens Caricion davallianae <input type="checkbox"/> 5421 - Black bog rush fens <input type="checkbox"/> 5422 - Brown bog rush fens - not Schoenus dominated <input type="checkbox"/> 544 - Acidic fens <input type="checkbox"/> 545 - Transition mires | | | | | | |
| NPWS Fen Types | | | | | | |
| <input type="checkbox"/> Warner - Reedbeds and other swamps <input type="checkbox"/> Warner - Fens & Flushes <input type="checkbox"/> Conaghan - Flushed Areas in BB <input type="checkbox"/> Derwin - Flushed areas in BB <input type="checkbox"/> Derwin - Fens and flushes in BB <input type="checkbox"/> Derwin - Quaking mires in BB | | | | | | |
| IPCC Fen Types | | | | | | |
| <input type="checkbox"/> Transition/reedbeds <input type="checkbox"/> Flood Plain Fen <input type="checkbox"/> Basin <input type="checkbox"/> Valley <input type="checkbox"/> Flush <input type="checkbox"/> Petrifying Springs | | | | | | |
| Habitat Information / Area Comments | | | | | | |
| <input type="text"/> | | | | | | |

Species Information Layout - NPWS Fen Study Database

| | | | | | |
|--|--|---------------------------------|---------------------|--|---------------------------|
| Survey of the Extent and Conservation Status of Fens in Ireland | | | | | Record Number 2689 |
| Main Layout | Habitats Recorded | NPWS Fen Study Area Information | Species Information | Summary Published Info/Surveys on site | Site Evaluation |
| Add reference to bibliography | Data sources various | Additional Layouts list | Basic Find Command | Various Finds Options | |
| Site Details | | | | | |
| SAC/NHA Site Name | <input style="width: 90%;" type="text"/> | | | | |
| SAC/NHA Site Code | <input style="width: 90%;" type="text"/> | | | | |
| Non SAC/NHA Name(s) or Subunit name within SAC/NHA Complex | BOG LAKE <input style="width: 90%;" type="text"/> | | | | |
| National Grid Reference | N 034 445 <input style="width: 90%;" type="text"/> | | | | |
| Rare Species Information | | | | | |
| Noteworthy Flora or Fauna | <input checked="" type="checkbox"/> Flora <input type="checkbox"/> Fauna | | | | |
| Flora species of note | Carex dioica x echinata hybrid <input style="width: 90%;" type="text"/> | | | | |
| Fauna species of note | <input style="width: 90%;" type="text"/> | | | | |
| Flora & Fauna Comments | <input style="width: 90%;" type="text"/> | | | | |

Summary Published Information/Surveys Layout - NPWS Fen Study Database

Survey of the Extent and Conservation Status of Fens in Ireland Record Number **205**

| | | | | | |
|----------------------------------|-------------------------------|---------------------------------|-------------------------|--|-----------------------|
| Main Layout | Habitats Recorded | NPWS Fen Study Area Information | Species Information | Summary Published Info/Surveys on site | Site Evaluation |
| Add published info for this site | Add reference to bibliography | Data sources various | Additional Layouts list | Basic Find Command | Various Finds Options |

Site Details

| | |
|--|----------------|
| SAC/NHA Site Name | MILLTOWN LAKES |
| SAC / Site Code | 002605 |
| Non SAC/NHA Name(s) or Subunit name within SAC/NHA Complex | |
| National Grid Reference | R 375 540 |

Summary of Survey Reports on Site

Date of last known survey 2001

Survey Comments
COC survey 2001

For non SAC/NHA fens further info may be found in **Data sources various**

Summary of Published Information on Site

To add a site report/ publication/ click on: **Add published info for this site** (button located above)

| | |
|---|---|
| 1 | Crushell P., 2000, Irish Fen Inventory - A review of the status of fens in Ireland , Irish Peatland Conservation Council, Dublin, pp. 100. |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Site Evaluation Layout - NPWS Fen Study Database

Survey of the Extent and Conservation Status of Fens in Ireland

Main Layout

Habitats Recorded

NPWS Fen Study Area Information

Species Information

Summary Published Info/Surveys on site

Data sources various

Record Number
205

Full Site Evaluation

Additional Layouts list

Basic Find Command

Various Finds Options

SAC/NHA Site Name

SAC/NHA Site Code

Non SAC/NHA Name(s)

Site Evaluation

| | |
|---|--|
| <p>Confirmed Fen type</p> <div style="display: flex; gap: 10px;"> <div style="border: 1px solid black; padding: 2px;"> <input type="checkbox"/> Cladium fen 7210/PF1 <input type="checkbox"/> Alkaline fen 7230/PF1 <input type="checkbox"/> Poor fen/PF2 </div> <div style="border: 1px solid black; padding: 2px;"> <input type="checkbox"/> Transition Mire 7140/PF3 <input type="checkbox"/> Petrifying Spring 7220/FP1 <input type="checkbox"/> Non calcareous spring/FP2 </div> </div> <p style="text-align: center; font-size: small;">Confirmed: 6 Fen Types Area (sum accurate & estimated area) </p> | <p>Possible Fen type</p> <div style="display: flex; gap: 10px;"> <div style="border: 1px solid black; padding: 2px;"> <input type="checkbox"/> Cladium fen 7210/PF1 <input type="checkbox"/> Alkaline fen 7230/PF1 <input type="checkbox"/> Poor fen/PF2 </div> <div style="border: 1px solid black; padding: 2px;"> <input checked="" type="checkbox"/> Transition Mire 7140/PF3 <input type="checkbox"/> Petrifying Spring 7220/FP1 <input type="checkbox"/> Non calcareous spring/FP2 </div> </div> <p style="text-align: center; font-size: small;">Possible: 6 Fen Types Area 6</p> |
|---|--|

| | |
|--|---|
| <p>Possible conservation importance of this site for key fen type (s) and/or rare species</p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <input checked="" type="checkbox"/> Low conservation value <input type="checkbox"/> Medium conservation value <input type="checkbox"/> High conservation value </div> | <p>Explanatory notes: Factors to be considered: extent of fen habitat area; presence of priority Annex 1 habitats or Annex 2 species; presence of rare species; geographic location/ rarity of habitat in county; Annex 1 fen designated SAC;</p> |
|--|---|

| | |
|---|--|
| <p>Known survey information on site</p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <input type="checkbox"/> Not studied <input checked="" type="checkbox"/> Poorly studied <input type="checkbox"/> Adequately studied <input type="checkbox"/> Extensively studied </div> | <p>Explanatory notes: Factors to be considered: confusion over some or all fen type present; disagreement between classification studies; lack of detailed description; no data within NPWS;</p> |
|---|--|

| | |
|---|---|
| <p>Accuracy of area information on fen habitats within site</p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <input type="checkbox"/> No area information <input checked="" type="checkbox"/> Limited estimated area information <input type="checkbox"/> Some area information <input type="checkbox"/> Complete accurate area information </div> | <p>Explanatory notes: No area - area extent unknown; limited - a rough estimate only available for some types; some - area has been defined/estimated in all fen types in some detail; complete - accurate map area has been defined following detailed mapping; MPSU data available;</p> |
|---|---|

| | |
|---|---|
| <p>Need for survey of site</p> <div style="border: 1px solid black; padding: 5px; background-color: #e0ffe0;"> <input type="checkbox"/> Low priority <input type="checkbox"/> Medium priority <input checked="" type="checkbox"/> High priority </div> | <p>Explanatory notes: Low - well studied site, recent studies, accurate area data, habitats present all defined; Medium - poorly studied site, studies pre-1990's, estimated area data only, confusion over habitats present; High - newly reported site; lacking site study, no area data, confusion over habitats present, Annex 1 habitats present;</p> |
|---|---|

Various Data Sources Layout - NPWS Fen Study Database

Survey of the Extent and Conservation Status of Fens in Ireland

Record Number **205**

Main Layout

Habitats Recorded

NPWS Fen Study Area Information

Species Information

Summary Published Info/Surveys on site

Site Evaluation

Data sources various

Additional Layouts list

Basic Find Command

Various Finds Options

Site Details

SAC/NHA Site Name

SAC/NHA Site Code

Non SAC/NHA Name(s) or Subunit name within SAC/NHA Complex

National Grid Reference

County

| | | | | | | |
|-----------------------------|-----------------------------|-----------------------------|--|-----------------------------|-----------------------------|-----------------------------|
| <input type="checkbox"/> AM | <input type="checkbox"/> CO | <input type="checkbox"/> FH | <input type="checkbox"/> LA | <input type="checkbox"/> MA | <input type="checkbox"/> SL | <input type="checkbox"/> WX |
| <input type="checkbox"/> AH | <input type="checkbox"/> DG | <input type="checkbox"/> GA | <input type="checkbox"/> LE | <input type="checkbox"/> ME | <input type="checkbox"/> TI | <input type="checkbox"/> WI |
| <input type="checkbox"/> CW | <input type="checkbox"/> DY | <input type="checkbox"/> KE | <input checked="" type="checkbox"/> LI | <input type="checkbox"/> MO | <input type="checkbox"/> TE | |
| <input type="checkbox"/> CV | <input type="checkbox"/> DW | <input type="checkbox"/> KD | <input type="checkbox"/> LF | <input type="checkbox"/> OF | <input type="checkbox"/> WA | |
| <input type="checkbox"/> CL | <input type="checkbox"/> DU | <input type="checkbox"/> KK | <input type="checkbox"/> LH | <input type="checkbox"/> RO | <input type="checkbox"/> WM | |

Information Sources

Site Source Information

IPCC list of sites from Crushell Fen Survey 2000
Submission from Geoff Hunt (2000); NL REF439

Other Group Site Description / Information

The area consists of two different lakes. The northern lake has an area of open water. The southern lake is similar to Ballyvogue.

Pat Warner Habitat Motivation

Pat Warner Species Information

IPCC Habitat Type

| | |
|---|---------------------------------------|
| <input checked="" type="checkbox"/> Fen | <input type="checkbox"/> Intermediate |
| <input type="checkbox"/> Northern Blanket | <input type="checkbox"/> Cutover |
| <input type="checkbox"/> Lowland Blanket | <input type="checkbox"/> Other |
| <input type="checkbox"/> Mountain Blanket | |
| <input type="checkbox"/> Raised Western | |
| <input type="checkbox"/> Raised Midland | |
| <input type="checkbox"/> Raised Northern | |

NPWS Region

IPCC Designations

| | | |
|-------------------------------|-------------------------------|--|
| <input type="checkbox"/> NNR | <input type="checkbox"/> pSPA | <input checked="" type="checkbox"/> RM |
| <input type="checkbox"/> BGR | <input type="checkbox"/> RAM | <input type="checkbox"/> SMR |
| <input type="checkbox"/> WHS | <input type="checkbox"/> pNHA | <input type="checkbox"/> ESA |
| <input type="checkbox"/> EDS | <input type="checkbox"/> NHA | <input type="checkbox"/> NP |
| <input type="checkbox"/> SAC | <input type="checkbox"/> ASI | <input type="checkbox"/> EE |
| <input type="checkbox"/> pSAC | <input type="checkbox"/> ASSI | <input type="checkbox"/> BIO |
| <input type="checkbox"/> SPA | <input type="checkbox"/> FNR | <input checked="" type="checkbox"/> FNHA |

IPCC Site Designations Notes

IPCC Owner Status

| | |
|--|--|
| <input type="checkbox"/> An Taisce | <input type="checkbox"/> Private |
| <input type="checkbox"/> Bord Na Mona | <input type="checkbox"/> Rspb |
| <input type="checkbox"/> Dept Of Agriculture N I | <input type="checkbox"/> Ulster Wildlife Trust |
| <input type="checkbox"/> Dept Of Environment N I | |
| <input type="checkbox"/> IPCC | |
| <input type="checkbox"/> National Trust | |
| <input type="checkbox"/> Npws | |
| <input type="checkbox"/> Other | |

IPCC Notes on Owner Status

NPWS Site Synopsis Description

Main Site Record Citation Data Entry Layout - NPWS Fen Study Database

Survey of the Extent and Conservation Status of Fens in Ireland

Site record for citation of reference/report

Main Layout

Create publication/ report record for this site

Lookup reference/report number

To add a publications or report record for the site you were browsing:

1. Make sure the reference is in the bibliography first - if you are unsure click the “**Lookup reference/report number**” button above.
2. Make a note of the reference or report code number
3. The click “Create publications/report” button above and enter the reference number for the publication in question into the green “reference code” field below. Filemaker does the rest for you.

Always create a publications record for a site that you were last browsing

Site Record Number 2701

Citation record number 376

SAC NHA Site Name BELLACORRICK BOG COMPLEX

SAC NHA Site Code 001922

Non SAC NHA Site Name SHRALAHY (540)

Reference Code 32

Amalgamated title Foss, P.J. & McGee, E., 1987, A survey to locate blanket bogs of scientific interest in County Mayo, Internal Report, Wildlife Service Dublin.

Main Bibliography Data Entry Layout - NPWS Fen Study Database

Survey of the Extent and Conservation Status of Fens in Ireland

Main Layout

Find Author

Add New Reference

Reference list in alpha order

To add a publications or report to the bibliography:

1. Make sure the reference is not already in the bibliography first - if you are unsure click the "Reference list in alphabetical order" button above.
2. Then return to the Main reference layout (this one)
3. The click "Add new reference" button above and enter the reference. Formats to be used are displayed to the left hand side of each data field below.

Fen Publications and Reports Bibliography

| | |
|--|--|
| Bibliog Number | 127 |
| Authors: surname, initials. | Wann, J. |
| Year | 1999 |
| Title: paper/ book/ chapter title followed by book it is in format: In: Author (ed/s.) book title | Some botanical observations in Co. Limerick (V.C.H.S) for the Atlas 2000 project |
| Journal, Publisher, Location, No. pages pp. X-Y. | Irish Botanical News, No.9: 32-35. |

Cited in Fen Study 2007 Report Yes

Consulted Info source in Fen 2006 Study - Sites and or info Yes

BB or RB NPWS report Yes

Appendix 7: NPWS Fen Study habitat classification scheme used for fens

Within the context of this Study of the Extent and Conservation Status of Springs, Fens and Flushes in Ireland fens have been classified into the 6 categories shown below. This classification scheme is based primarily on the floristics of vegetation types that correspond to these fen types.

Further information on the phytosociology of these 6 fen types can be found in Chapter 4. While the summary Table x.x in Chapter 6 shows a summary of how the classification scheme used in the NPWS Fen Study relates to the other classification schemes described earlier in Chapter 4 (ie EU Habitats Directive fen types; CORINE; Fossitt etc.).

7.1 Transition mires and quaking bogs (7140/PF3)

Scheuchzerietalia palustris to Caricetalia nigrae communities;
medium sized or small sedges with Sphagnum or brown mosses

Fen vegetation corresponding to this fen category can be found in or association with:
Floating carpets or quaking mires in larger blanket bog systems
Floating carpets or quaking mires in raised bog systems
Secondary fen areas on cutover and cutaway bogs
Minerotrophic fens outside of larger mire complexes
Small fens in the transition zone between water (lakes, ponds) and mineral soil

Examples of this fen type:
Lough Roe, Clara Bog, Offaly
Scragh Bog, Westmeath
Holdenstown Bog, Wicklow
Drumgallan, Monaghan
Fenor Bog, Waterford
Meenaguse Scragh, Donegal

7.2 Calcareous fens with *Cladium mariscus* (*7210/PF1)

Magnocaricion - Cladietum marisci to Caricetalia davallianae communities

Fen vegetation corresponding to this fen category can be found in or association with:
Cladium mariscus beds of the emergent-plant zones of lakes
Cladium stands in blanket bog flushes
Cladium stands on regenerating cutaway bog
Contact areas within calcareous fens (7230)
Contact areas within acid fens
Contact areas with reedbeds and tall sedge communities
Extensive wet meadows

Examples of this fen type:
Pollardstown Fen, Kildare
East Burren Complex, Clare
Lough Lurgan, Galway
Connemara Bog Complex, Galway
Askeaton Fen Complex, Limerick

7.3 Alkaline fens (7230/PF1)

Caricetalia davallianae communities;

with small sedges and brown mosses, with or without *Schoenus nigricans*, and possible patchy cover of *Phragmites*, *Cladium*, *Typha* or *Carex paniculata*

Fen vegetation corresponding to this fen category can be found in or association with:

- Fens outside of larger mire complexes
- With spring communities developing in depressions
- Within tall sedge and reedbed communities
- In association with *Cladium* fen sedge beds
- Small areas in dune slack systems
- In association transition mires
- In wet grasslands
- On tufa cones
- Within machair
- Within turloughs

Examples of this fen type:

- Pollardstown Fen, Kildare
- Buckronev-Brittis Dunes & Fen, Wicklow
- Scragh Bog, Westmeath
- Bunduff Lough & Machair, Sligo
- Askeaton Fen Complex, Limerick
- Bellacorick Bog Complex, Mayo
- East Burren Complex, Clare

7.4 Poor Fens (PF2)

Caricion curto-nigrae communities;

with medium to small sedge and brown mosses or *Sphagnum*, and possible patchy cover of *Phragmites*

Fen vegetation corresponding to this fen category can be found in or association with:

- Poor fen flushes in blanket and raised bog
- Soligenous mires on peat or peaty mineral soils in blanket bog
- Soligenous depressions among grassland
- Flushes in wet heath
- Regenerating communities on cutover bog

Examples of this fen type:

- Bellacorrick Bog Complex, Mayo
- Boleybrack Mountain, Leitrim
- Cloghernagore Bog and Glenveagh National Park, Donegal
- Connemara Bog Complex, Galway
- Ox Mountain Bogs, Sligo
- Wicklow Mountains National Park, Wicklow

7.5 Petrifying springs with tufa formation -and calcareous springs (* 7220/FP1)

Cratoneurion communities

rich in lime, usually dominated by bryophytes

Fen vegetation corresponding to this fen category can be found in or association with:

Forest environments

Open countryside

Heathlands

Contact areas within calcareous fens (7230)

Calcareous / Machair grasslands

At base of esker ridges

Karst/Limestone area

Seepage lines on lime rich inland and sea cliffs

Examples of this fen type:

Pollardstown Fen, Kildare

Knocksink Wood, Wicklow

Benbulbin plateau, Lafrgy Bog, Sligo

Errisbeg, Galway

Ballyman Glen, Wicklow

7.6 Non-Calcareous springs (FP2)

Montio - Cardaminetea communities

poor in lime, dominated by bryophytes

Fen vegetation corresponding to this fen category can be found in or association with:

Vegetation of cold springs, commonly dominated by bryophytes

Warm water springs

Springs in blanket bog

Seepage lines on cliffs and base of clay cliffs poor in lime

Examples of this fen type:

Bellacorick, Mayo

Appendix 8: Glossary of terms used

ABIOTIC - Of or relating to the non-living components of a habitat or ecosystem

ACIDIFICATION - The detrimental effect of acid rain on soils and freshwater.

AFFORESTATION - The planting of trees (usually conifers) over an area of previously unplanted ground.

ALTITUDE - Vertical height above sea level.

ALLUVIAL - Of or relating to silty deposits transported by water, or occurring on river flood plains

AMPHIBIANS – A vertebrate group whose members spend part of their life cycle in water and part on land e.g. Frog.

ANNEX 1 - of the EU Habitats Directive, lists habitats including priority habitats for which SACs have to be designated.

ANNEX 2 - of the EU Habitats Directive is a list of species for which SACs have to be designated.

ANNUAL PLANT - Plant that completes its life cycle within a single growing season

AQUATIC ENVIRONMENT – Rivers, streams, lakes, ponds, springs and features that depend on natural waters e.g. marsh, bogs and wetlands.

ASIs - Areas of Scientific Interest. Areas that were identified in the 1970s as being of conservation interest. The NHA designation developed from ASIs.

BASE POOR SOILS - Soils that only slowly release the dissolved chemicals or minerals contained within them.

BASIN - A depressed area of the Earth's surface, in which sediments accumulate.

BIODIVERSITY – A general term used to describe all aspects of biological diversity, including: the number of species present in a given environment; the genetic diversity present within a species; the number of different ecosystems present within a given environment.

BIOTOPE - An environmental region, defined by certain conditions characteristic organisms that typically inhabit it. Combination of the physical habitat and its recurring community of animals and plants

BIOTIC - Of or relating to the living components of a habitat or ecosystem

BIRDS DIRECTIVE (Council Directive 79/ 409/ 2nd April 1979) - Under this Directive Ireland is required to conserve the habitats of two categories of wild birds: 1) Listed rare and vulnerable species and 2) Regularly occurring migratory species. The Directive also obliges Ireland to conserve wetlands, especially those of international importance and regulates the hunting and trading of wild birds. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

BLANKET BOG - Bogs which carpet the landscape, following the underlying topography. They can cover extensive areas along the west coast and on uplands throughout the country.

BOG - General term for ombrotrophic mire or peatland (but sometimes used colloquially for other wetland type e.g. marsh, fen). A peat filled or covered area.

BORD NA MÓNA - Irish peat extraction board, founded by the Irish state in 1946.

BOULDER - Large rock that is greater than 256 mm in diameter

BRACKISH - Where salinity is intermediate between that of freshwater and sea water

BRYOPHYTES - A group of simple non-vascular spore-bearing green plants comprising the mosses, liverworts and hornworts.

CALCAREOUS - Rich in calcium salts (lime-rich), or pertaining to limestone or chalk

CALCICOLOUS - Organisms that have an affinity for habitats that are rich in calcium (lime-loving)

CALLOW - Wetland areas at edge of large rivers, that were or are are still seasonally regularly flooded. May contain fen vegetation, but often with a peat layer less than 40 cm deep.

CATCHMENT - An area of land draining to a defined point. The term river catchment refers to the area of land that drains into a particular river system.

CLAY - Very fine sediment particles that are less than 0.004 mm in diameter - component of mud

COLONISATION - The entry and spread of a species into an area, habitat or population from which it was formerly absent.

COMMONAGE - An area of land which are undivided but are owned by more than one person / or the rights to use the land are owned by more than one person.

COMMUNITY - a well-defined assemblage of plants and/or animals, clearly distinguishable from other such assemblages.

CONSERVATION STATUS - The sum of the influences acting on a habitat and its typical species that may affect its long term distribution, structure and functions. Also refers to the long-term survival of its typical species within the European territory of the Member States.

CORINE - An information and mapping system, developed within the context of the Commission of the European Communities biotope project, which is used as a tool for the description of sites of importance for nature conservation in Europe. It catalogues recognisable communities of flora and fauna. The primary objective of this catalogue is to identify all major communities whose presence contributes to the conservation significance of a site. Included in this list of communities are interesting but rare natural or near-natural communities as well as the more widespread seminatural ones.

CUTAWAY BOG - Areas of bog which have been systematically cut, by mechanical means. Any peat remaining has no economic value. Underlying mineral soil or marl layer or bedrock often exposed. Cutaway areas are normally a mosaic of cut areas, drainage ditches, flooded area, uncut higher banks of peat, scrub, grassland etc.

CUTOVER BOG - Areas of bog which have been previously cut, although not down to the marl layer or bedrock. Often using traditional hand-cutting methods. Cutover areas are normally a mosaic of cut areas, face banks, pools, drainage ditches, uncut areas of peat, scrub, grassland etc.

DRAW-DOWN ZONE - Area exposed when water levels are reduced, normally as a result of abstraction in the case of reservoirs, or of drying out in the case of ponds

DIVERSITY - see biodiversity.

DOMESTIC PURPOSES - Used in relation to the cutting of peat. Peat that is cut for domestic purposes is not for commercial sale and is cut at the rate of one year's supply for a household per year.

DRUMLIN - Streamlined, oval-shaped hill formed by glacial activity and usually comprising unsorted sediment, or till

DYSTROPHIC – shallow lake that is a dark brown colour due to the presence of organic material, and are of low biological productivity and have poor light penetration

ECOLOGY - The study of the interactions between organisms, and their physical, chemical and biological environment.

EDAPHIC - Of the soil, or influenced by the nature of the soil

ENVIRONMENT – The biological and physical conditions in which an organism lives.
EPA – Environmental Protection Agency

EMERSED - Above the level of the water, or exposed to air

EPIBIOTA - Surface-dwelling animals and plants

EPIFAUNA - Surface-dwelling animals

EROSION - The processes whereby the materials of the Earth's crust are dissolved, or worn away and simultaneously moved from one place to another by natural agencies which include weathering, solution, corrosion and transportation.

EUROPEAN BIRDS DIRECTIVE (79/ 409/ 2nd April 1979) - See Birds Directive.

EUTROPHIC – Biological effects of an increase in plant nutrients on aquatic systems

ESKER - Long, sinuous, steep-sided ridge, comprising layers of sediments (cross-bedded sands and gravels) laid down by glacial melt waters

EUTROPHIC - Having high levels of primary productivity or nutrients

FAUNA - Animal life.

FAVOURABLE CONSERVATION STATUS - The conservation status of a natural habitat will be taken as "favourable" when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FEN - General term for minerotrophic mires, formed under the influence of groundwater.

FLORA - plant life.

FORMATION – A geological term for a body of rocks having easily recognised boundaries that can be traced in the field, and large enough to be represented on a geological map as a practical and convenient unit for mapping and description.

GEOMORPHOLOGY – The study of the form and structure of the landscape, which is shaped

by the underlying geology.

GLEYS - Soil type subject to water logging because of the high content of impermeable clays

GRAVEL - Sediment particles that are between 4-16 mm in diameter

HABITAT - Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species home. In the Habitats Directive this term is used more loosely to mean plant communities and areas to be given protection.

HABITATS DIRECTIVE - (Council Directive 92/43/EEC). The Directive on the conservation of Natural Habitats and of Wild Flora and Fauna. This Directive seeks to legally protect wildlife and its habitats. It was transposed into Irish legislation by the EU (Natural Habitats) Regulations, 1997.

HAND CUTTING OF PEAT - Refers to traditional cutting of peat using a slean or spade.

HERBACEOUS - Of or relating to non-woody plants or vegetation

HUMIC ACID - Dark brown acid derived from humus or partially decomposed organic material in soils, particularly peats

HUMMOCK - A small hillock/mound. Often used to describe the surface of active bogs where the ground forms a pattern of mounds, hollows and pools. Such hummocks commonly comprise bog mosses.

HYDROLOGY - The movement of water through a catchment area including freshwater and seawater inputs, water level changes and drainage mechanisms which are all influenced by the underlying geology.

HYPERTROPHIC - Over-enriched with nutrients, polluted

IMMERSED - Submerged by water

IPCC - Irish Peatland Conservation Council. Non-governmental organisation established in 1982 to promote the protection of Irish bogs and fens.

LAGG - Fringing wetland area around raised bogs where groundwater mixes with bog water, and where vegetation communities are transitional between bog and fen

LATITUDE - The angular distance measured in degrees north or south of the equator.

LICHENS - An organism that consists of a fungus growing in close association (symbiosis) with an alga.

LOAM - Friable or crumbly soil comprising sand, silt, clay and organic matter

MANAGEMENT - a) Controlling processes within a site (this can be actively carrying out work or can be doing nothing), preferably in accordance with a conservation plan. - b) The practical implementation of the management plan. - c) Undertaking any task or project identified in the management plan, including the identification of new opportunities.

MARGINAL VEGETATION - At or near the margin or border, often used to describe the vegetation at the edge of a lake or river.

MARL - White calcareous clay or precipitate with a high proportion of soft calcium carbonate, usually found as an alluvial deposit

MARSH - Wet grassy habitats, with more or less permanent standing water at or near ground level, with little or no peat formation. Generally quite species rich.

MECHANICAL PEAT EXTRACTION - Refers to the use of machinery to cut peat. This includes extrusion cutting such as by sausage machine (e.g. Difco) or any other type of mechanical cutter (e.g. Hopper).

MESOTROPHIC – freshwater lake systems containing moderate concentrations of mineral nutrients, such as phosphorous, calcium and nitrogen. Having moderate levels of primary productivity or nutrients (intermediate between oligotrophic and eutrophic)

MICROTOPOGRAPHY - Very small-scale variations in the height and roughness of the ground surface.

MINEROTROPHIC MIRE - A peatland system that is fed by ground water.

MIRE - A general term applied to peat producing ecosystems. cf. bog, peatland.

MONITORING – A repeat or repeats of a survey using the same methodology. Designed to look for or measure specific changes and the rate or extent of change. Used to check the “health” quantity or quality of a habitat or species.

MONTANE - Of or relating to mountains

MOOR - Shallow acid peatland less than 40 cm peat depth, often resting on iron pan and podzol; and dominated by ericaceous vegetation.

MOR HUMUS - Organic soil that is acid and comprises layers of plant litter

MORaine - Ridge or mound of unsorted mineral material deposited by glaciers

MOSAIC - Used to describe habitats that occur together and cannot easily be mapped separately. Complex pattern or patchwork of habitats or species occurring in intimate associations

MUD - Silt/clay fraction where sediment particles are less than 0.063 mm in diameter

MULTIPLE PRIVATE OWNERSHIP- Lands that are divided into areas which are privately owned. There must be more than one private landowner under this heading. (lands in commonage are not described under this heading).

NATIONAL PARKS AND WILDLIFE SERVICE (NPWS) – the section of the Environment Infrastructure and Services division of the Department of Environment, Heritage and Local Government with responsibility for nature conservation and implementation of Government conservation policy as enunciated by the Minister for the Environment, Heritage and Local Government.

NATURA 2000 - A network of sites across the European Community, selected for the purpose of conserving natural habitats and species of plants and animals which are rare, endangered or vulnerable in the European Community. SACs and SPAs form the Natura 2000 network.

NATURAL HABITAT - Can be aquatic or terrestrial areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural.

NHAs - Proposed Natural Heritage Areas. These are areas that are important for wildlife conservation. Some of these sites are small, such as roosting areas for rare bats; others can be large such as a blanket bog or a sand dune system.

NNR - National Nature Reserve. Areas set aside for their conservation value by the Minister for the Department of Environment, Heritage and Local Government.

NOTABLE SPECIES - Plants or animals which are worthy of mentioning either because they are particularly typical of a habitat, or because they are rare/ scarce/ atypical.

NPWS - National Parks and Wildlife Service (see above)

OLIGO – Prefix denoting few or little

OLIGOTROPHIC - Applied to waters that are relatively low in nutrients, as in lakes which are low in dissolved minerals and which can only support limited plant growth. Having low levels of primary productivity or nutrients

OMBROTROPHIC - Rain-fed, of or relating to vegetation or ecosystems that receive most of their nutrients from precipitation

OS – Ordnance Survey

PEAT - Organic soil material saturated by water, composed of the partial decomposed remains of plants and mosses.

PEAT CUTTING BY HAND - See hand cutting of peat.

PEAT CUTTING BY MACHINE - See mechanical peat extraction.

PEBBLE - Sediment particle, or stone, that is between 16-64 mm in diameter

PERIPHERY - Distant from the centre, on the fringe/edge.

pH - A quantitative expression for the acidity or alkalinity of a solution or soil. The scale ranges from 0-14: pH 7 is neutral, less than 7 is acidic and greater than 7 is alkaline.

PLATEAU - A wide, mainly level area of elevated land.

PHYTOSOCIOLOGY - Study and classification of plant communities based primarily on floristic considerations

PODZOL - Acid soil with an organic layer over a highly leached mineral layer

PRECIPITATION - Water moving from the atmosphere to the ground in the form of rain, fog, mist, snow or hail.

PRIORITY HABITAT - A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

RARE - An ecological term applied to distribution of species when assessed on a national grid reference system. The assessment is made on the basis of the number of occupied 10 km National Grid squares. A species is described as rare if has been recorded in to 3-10, 10 km squares.

RED DATA BOOK – A register of threatened species that includes definitions of degrees of threat.

RED DATA BOOK (lower plants) - This Red Data Book deals with Stoneworts which are recognised as a separate class, Characea, of the Green Algae Chlorophyta). Many of these

species are threatened by loss of habitat or pollution.

RED DATA BOOK 1 (vascular plants) This Red Data Book deals with rare and threatened flowering plants and ferns of Ireland with an account of their present distributions and conservation status.

RED DATA BOOK 2 (mammals, birds, amphibians and fish) - identifies those species threatened in Ireland or those species whose populations are considered to be of international importance, though not necessarily threatened in Ireland. It details the current state of Irish vertebrates and provides a concise summary of the various legislation for each species.

RIPARIAN - Of or relating to a river bank

SACs - Special Areas of Conservation have been selected from the prime examples of wildlife conservation areas in Ireland. Their legal basis from which selection is derived is The Habitats Directive (92/43/EEC of the 21st May 1992). SAC's have also been known as cSAC's which stands for "candidate Special Areas of Conservation", and pcSAC's which stands for "proposed candidate Special Areas of Conservation."

SCIENTIFIC MONITORING - this is carried out by the monitoring section of the NPWS, whose function here is to ensure that the favourable conservation status of the site is maintained and where possible improved.

SEDIMENT - Solid particles that can originate by the weathering and erosion of pre-existing rock, by chemical precipitation from water, or by the breakdown of organisms.

SEDIMENTARY - Formed by the deposition of sediment, i.e. rock particles or chemical precipitate, or pertaining to the process of sedimentation.

SILICEOUS - Of or relating to rocks or sediments that contain silica and are acid

SILT - Fine sediment particles that are between 0.004-0.063 mm in diameter - component of mud

SINKHOLE - Steep-sided, enclosed depression linking to underground drainage systems in a limestone region

SLACK - Wet depression in a sand dune system or, in the case of rivers, a backwater

SPAs - Special Protection Areas for Birds are areas which have been designated to ensure the conservation of certain categories of birds. Ireland is required to conserve the habitats of two categories of wild birds under the European Birds Directive (Council Directive 79/409/ 2nd April 1979). The NPWS is responsible for ensuring that such areas are protected from significant damage.

SPECIES - the lowest unit of classification normally used for plants and animals.

STRATEGY - A course of action or a broad approach towards achieving an objective. It is the general thrust of management towards achieving an objective. It is a description of how the objective is to be achieved.

SUBMERSED - Submerged or covered by water

SURVEY - a) Study/visit to produce an inventory of what is present / record a situation.- b) Establishing a baseline (study).

SUSTAINABLE - The highest rate at which a renewable resource can be used without reducing its supply (without causing damage to the resource).

TILL - Unsorted sediments laid down directly by glacier ice without the intervention of water

TRANSITION MIRE – Acidophilous vegetation intermediate between poor fen and ombrotrophic (rain-fed) bog.

TROPHIC - Of or relating to nutrient levels or nutrition

TUFA - Deposit or precipitate of calcium carbonate around calcareous springs

TURBARY – Refers to the right to harvest turf.

VASCULAR PLANTS - Higher plants with specialised conducting tissue, including angiosperms (flowering plants), ferns and clubmosses

VERTEBRATES - Animals with backbones.

VERY RARE - an ecological term which is applied to distribution of species when assessed on a national grid reference system. The assessment is made on the basis of the number of occupied 10 km National Grid squares. Very Rare applies to 1-2, 10 km squares in this context.

WEATHERING - The process by which rocks are broken down and decomposed by the action of wind, rain temperature changes, plants and bacteria. See also chemical and mechanical weathering.

ZONING - The division of a nature conservation site (& neighbouring lands) into a number of subunits. Within each zone the management prescriptions will be reasonably uniform and will differ in type or intensity from the other zones in the plan.

Appendix 9: NPWS Fen Study Site lists

Contents

- 9.1 NPWS Fen Study Database total site list with conservation designations, fen types and total fen area recorded. Sorted by County, and then SAC/NHA site code number.
- 9.2 NPWS Fen Study Database list of SAC designated for EU Habitats Directive Annex 1 fens with total site area (SAC), fen types and total fen area recorded. Sorted by SAC site code number.
- 9.3 NPWS Fen Study Database list of all SAC, cSAC and pcSAC with total site area, fen types and total fen area recorded. Sorted by SAC site code number.
- 9.4 NPWS Fen Study Database list of newly reported undesignated sites with fen types and total fen area recorded. Sorted by County; and then site name.