The National Vegetation Database: Guidelines and Standards for the Collection and Storage of Vegetation Data in Ireland Version 1.0

Irish Wildlife Manuals No. 49

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

The National Vegetation Database: Guidelines and Standards for the Collection and Storage of Vegetation Data in Ireland

Version 1.0

Lynda Weekes and Úna FitzPatrick

National Biodiversity Data Centre

Beechfield House,

WIT, West Campus,

Carriganore

Waterford

Citation:
Weekes, L.C. & FitzPatrick, Ú. (2010) The National Vegetation Database: Guidelines and Standards for the Collection and Storage of Vegetation Data in Ireland. Version 1.0. *Irish Wildlife Manuals*, No. 49. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Cover photo: © L.C. Weekes

Irish Wildlife Manuals Series Editors: N. Kingston & F. Marnell

ISSN 1393 – 6670

CONTENTS

EXECUTIVE SUMMARY 2

ACKNOWLEDGEMENTS 3

INTRODUCTION 4
- **Background to vegetation science in Ireland** 4
- **The establishment of the National Vegetation Database** 5
- **Advisory group** 5
- **Project aims** 6
- **Database Structure** 7
- **Status in 2010** 7
- **The value of National Vegetation Database at present** 10
- **The value of the National Vegetation database in the future** 10
- **The wider context** 11

DATA STANDARDS WITHIN THE NATIONAL VEGETATION DATABASE 13
- **Data standards** 13
- **Taxonomic standards** 13
- **Data quality** 15
- **Metadata required with each survey** 15
- **Data sharing agreement** 16

GUIDELINES FOR THE COLLECTION OF VEGETATION DATA IN THE FIELD 18
- **Field recording card** 18
- **Turboveg CE** 18

GUIDELINES FOR THE STORAGE AND MANAGEMENT OF VEGETATION DATA 20
- **How vegetation data should be digitally stored** 20
- **Turboveg** 20

THE USE OF TURBOVEG SOFTWARE 21
- **Compatible programs** 21
- **System Requirements** 22
- **Website** 22
- **Advantages of using Turboveg for recording and storing vegetation data** 22
- **The Turboveg model** 22
- **Creating a Turboveg database that is compatible with the National Vegetation Database** 23
- **Step by step guide to setting up Turboveg file** 23

CONCLUDING REMARKS 33

REFERENCES 34

APPENDIX I: DEFAULT TURBOVEG DATA FIELDS 36

APPENDIX II: ADDITIONAL GENERAL USE TURBOVEG DATA FIELDS 39

APPENDIX III: EXCEL DATABASE OF MORE SPECIALISED TURBOVEG DATA FIELDS 40

APPENDIX IV: LIST OF ALL DATASETS IN THE DATABASE (SEPTEMBER 2010). 52

EXECUTIVE SUMMARY

- The National Vegetation Database was established in 2007 by the National Biodiversity Data Centre, in conjunction with the National Parks and Wildlife Service. The database is coordinated and managed by the Data Centre, and has an advisory group consisting of Ireland's leading vegetation scientists to oversee its development.
- The National Vegetation Database provides a stable, long-term digital storage facility for vegetation data in Ireland. The data is stored using vegetation data management software called Turboveg. Turboveg was designed to store phytosociological vegetation data and is used by the European Vegetation Survey. The software contains multiple export functions to a range of analytical tools for vegetation data and can also be linked to an information management system that includes spatial data.
- The National Biodiversity Data Centre has identified data standards for the incorporation of vegetation data into the national database, and has published recommendations for the collection and digital storage of vegetation data in Ireland. It has worked with the Turboveg developer to optimise the use of the software for the storage of Irish vegetation data; and provides free support and training on the storage and management of vegetation data in Ireland.
- It is expected that that there will be in excess of 25,000 relevés in the National Vegetation Database when the digital capture of accessible, existing vegetation data is completed in 2012.
- The National Vegetation Database creates a core building block from which a future national vegetation classification system can be developed. A vegetation classification system for Ireland would allow us to accurately describe our vegetation resource and provide sound scientific advice for nature conservation, particularly in protected site selection.
- The National Vegetation Database provides a comprehensive national baseline. It will allow us to design statistically valid sampling schemes to answer important questions on changes in our habitats, vegetation and species.
- From 2012 the database will be used to create map layers showing the distribution of habitats and vegetation communities in Ireland; and will assist with reporting on implementation of the Habitats Directive (Article 17). Since establishment, it has been contributing to European initiatives and supporting the work of the research community in Ireland.
- The National Biodiversity Data Centre maintain an up-to-date website on the National Vegetation Database which provides detailed information on the project, along with extensive vegetation resources available for download: www.nationalvegetationdatabase.biodiversityireland.ie

ACKNOWLEDGEMENTS

The National Vegetation Database is managed by the National Biodiversity Data Centre, but the development of the database has been made possible through the financial support of the National Parks and Wildlife Service. The NPWS funded a national vegetation audit in 2007, which identified sources of vegetation data in Ireland and is core to the project. Since 2007, they have also provided funding for a research officer post in the Data Centre, focused on data digitization. Special thanks are extended to Dr Naomi Kingston of the NPWS for continual advice and support on the development of the National Vegetation Database.

The authors are grateful to Dr Stephen Hennekens (Alterra, Wageningen, The Netherlands) who developed Turboveg, and who has provided constant support during the establishment phase of the national Turboveg database in Ireland.

Thanks to Dr Matthew Jebb of the National Botanic Gardens, who provided an Irish plant checklist that forms the taxonomic basis of the National Vegetation Database.

Thanks to the previous research officers within the National Biodiversity Data Centre who have carried out the digitization of more than 17,000 relevés, and made creation of the database possible: Ellen O'Sullivan, Colette O'Flynn, Melinda Swann and Nicola Foley. The support and expertise provided by the Advisory Group is also greatly appreciated.

A special word of thanks is given to all those who have contributed data to the National Biodiversity Data Centre for digitisation and incorporation to the National Vegetation Database. A full list of contributors and sources to date can be viewed in Appendix IV. Without such co-operation and support, the National Vegetation Database would not exist.

INTRODUCTION

Background to vegetation science in Ireland

Vegetation refers to the cover provided by plants within our landscape. The influence of climate, soil, topography, and land use history result in the development of a discreet number of different plant communities or vegetation types. Describing these different vegetation types enables us to more fully understand our natural environment and how it is changing. Vegetation is commonly studied using phytosociological methods, which determine the alliances between plants using information gathered from vegetation samples known as relevés. In Ireland the dawn of vegetation surveying based on phytosociology came after the excursion of Braun-Blanquet and Tüxen in the 1950s (Braun-Blanquet & Tüxen, 1952). Most of the vegetation studies completed since this time have been based on phytosociological methods.

University College Dublin built up enormous expertise, and led the way in vegetation studies throughout the 1970s. During that time they collected a large volume of data, particularly on coastal vegetation. White and Doyle, lecturers at UCD were later to publish an account of Irish vegetation types in 1982 (White & Doyle, 1982). This paper informed the Heritage Council's national habitat classification system (Fossitt, 2000) and, in the absence of a national vegetation classification system, underpins what we know about Irish vegetation today. The Fossitt habitat classification system is mainly based on the presence or absence of vegetation communities or particular plant species, while also taking abiotic factors such as geology and hydrology into account.

A large volume of Irish vegetation data was also collected by researchers in National University of Ireland, Galway and to a lesser extent, Trinity College Dublin in the 1980s and 1990s. An important advance during this time was the development of an efficient software solution for the storage and manipulation of vegetation data by Prof. Michael O'Connell in NUIG (FORTRAN programme, NPHYTO; now obsolete). Irish vegetation surveys following traditional phytosociological methods continued into the twenty first century, but to a lesser degree.

At present, there are very few active vegetation research groups within the Irish Academic community. Concerns are often expressed about the emphasis on applied botany in third level institutions, and an apparent move away from traditional botanical field practices within the universities. This may lead to decline in availability of trained vegetation scientists and surveyors in the future.

The majority of vegetation studies being currently undertaken are by the National Parks and Wildlife Service as part of ongoing national habitat surveys. These include upland habitats, grassland, limestone pavement and petrifying springs. Among those completed are; a national survey of native Irish woodlands (Perrin *et al.*, 2008) and a coastal survey (mainly dunes) (Ryle *et al.*, 2009). Guidelines for present and future habitat and mapping projects are laid out in the Heritage Council's best practice guidance for habitat survey and mapping (Smith *et al.*, 2010).

As part of the development of the National Vegetation Database, the National Parks and Wildlife Service funded a national vegetation audit to identify the main sources of vegetation data in Ireland (O'Sullivan & FitzPatrick, 2007). The audit was carried out by the National Biodiversity Data Centre and identified in excess of 19,000 existing Irish vegetation relevés. It found that 63% of the existing

Irish vegetation sources come from academia, 29% from the National Parks and Wildlife Service, and 8 % from independent sources such as private consultants (Figure 1).

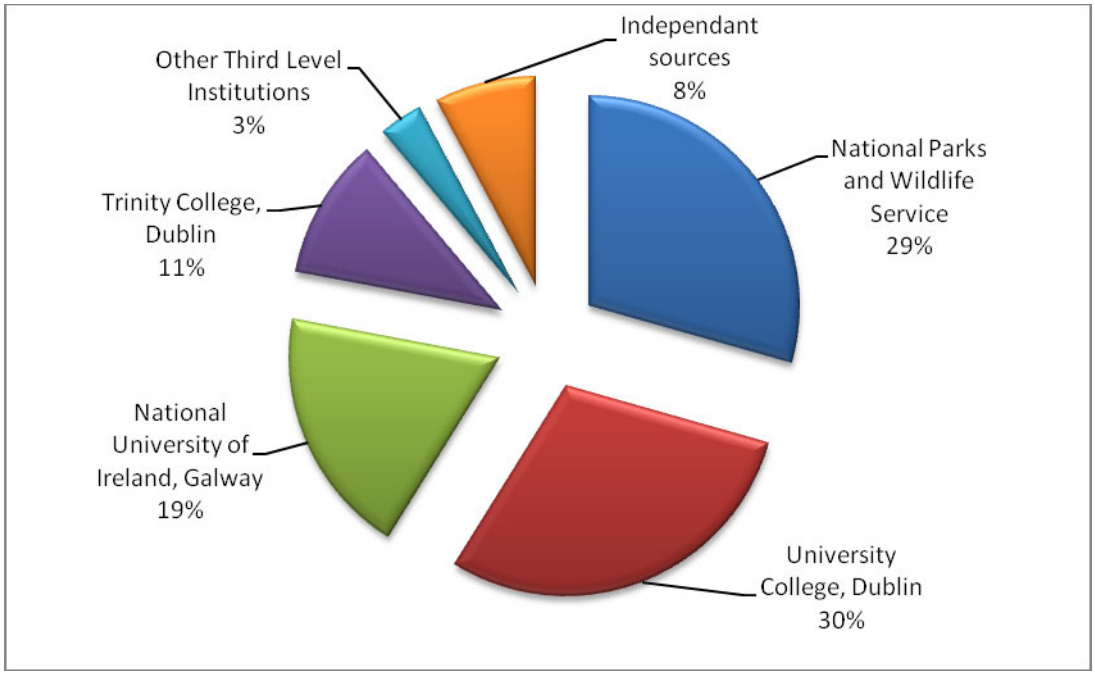


Figure 1: Pie chart showing the % distribution of relevé sources identified in the audit carried out by the National Biodiversity Data Centre in 2007.

The establishment of the National Vegetation Database

The National Vegetation Database was established in January 2007 by the National Biodiversity Data Centre at the request of the National Parks and Wildlife Service. Since establishment, the NPWS have provided funding for a research officer within the Data Centre to work on development of the database. Following a scoping study, it was decided that the database would be stored within vegetation data management software called Turboveg. Turboveg is the accepted standard for the storage of phytosociological vegetation data (Hennekens & Schaminee, 2001) and is used by the European Vegetation Survey. In 2008 the National Botanic Gardens provided an Irish plant checklist which now forms the taxonomic basis of the National Vegetation Database. The 2007 national vegetation audit, carried out by the Data Centre provisionally identified in excess of 19,000 existing Irish relevés which should be incorporated into the national database. Since then, this figure has been substantially increased, and 21,000 relevés have been digitised to date. The capture of existing Irish vegetation data will be completed in 2012, when it is expected that the database will contain in excess of 25,000 relevés. Ongoing national habitat surveys being carried out by the NPWS should increase this figure to in excess of 28,000 relevés over the coming 5 years.

Advisory group

When the National Vegetation Database was established in 2007, an advisory group was set up to over-see its development. This group consists of 17 individuals, and includes members from key organisations along with Ireland's leading vegetation scientists (Table 1).

Table 1: The National Vegetation Database Advisory Group in 2010.

Organisation	Name
National Parks and Wildlife Service	Dr Naomi Kingston Dr Andy Bleasdale Ms Marie Dromey
Environment and Heritage Service	Dr Mark Wright
National Botanic Gardens	Dr Noeleen Smyth
Teagasc	Dr John Finn
Botanical Society of the British Isles	Dr Caroline MhicDaeid Dr Stephen Ward
Professional ecologists	Dr John Conaghan Mr Edwin Wymer Dr Philip Perrin
University College Dublin	Dr Tamara Hochstrasser
University of Ulster Coleraine	Dr Alan Cooper
Trinity College Dublin	Prof. Fraser Mitchell
CEDaR	Dr Damien McFerran
National Biodiversity Data Centre	Dr Liam Lysaght Dr Úna FitzPatrick

Project aims

Through consultation with the National Parks and Wildlife Service and the advisory group, the aims of the National Vegetation Database were formalised in 2008. These aims are listed below:

1. To create a stable long-term digital storage facility for vegetation data in Ireland.
2. To populate this database with existing current and historical Irish vegetation data.
3. To establish a baseline vegetation dataset for Ireland and a facility to track and monitor changes in Irish vegetation.
4. To provide data collection standards for future studies on Irish vegetation.
5. To use the database to create a vegetation classification system for Ireland that can be integrated into the current habitat classification system and that will play a role in monitoring and reporting on habitat quality.
6. To create a web based interface to display vegetation data for Ireland.

7. To contribute a core building block towards an integrated information system for the management of plant species, vegetation and landscape data in Ireland.
8. To contribute Irish vegetation data to wider European initiatives such as SynBioSis Europe.

Database Structure

The National Vegetation Database is a digital database, stored using vegetation data management software called Turboveg (v2.84; as of 28/9/10). Through consultation with Stephen Hennekens (Turboveg developer), an Irish plant checklist provided by the National Botanic Gardens was incorporated into the software in 2008, and is included as standard with versions of Turboveg supplied to Ireland. All data held in the National Vegetation Database is based on this taxonomy.

The core structure of the database is fixed to ensure standardization across individual datasets; however flexibility is permitted in terms of data fields to reflect the differing information held in individual surveys. Datasets are not combined within the core database, but are held as separate surveys (a parallel combined database is held by the Data Centre, and used to gather key statistics on the data as it is accumulated). Holding data within individual surveys, grouped by the Fossitt habitat classification system (Fossitt, 2000), facilitates the provision of data to other national initiatives, where appropriate e.g. The National Grassland Survey. Within Turboveg it is possible to retain the data in individual surveys, but to search across the entire database for particular assemblages of species or ecological characteristics, and extract these relevés for analysis.

Each dataset within the National Vegetation Database is accompanied by a cover page and a data entry log. These are held in an associated database. The cover page provides a succinct description of the dataset, along with any relevant notes or explanations about its digitisation. The data entry log is a record of any necessary changes made to the raw data during digitisation. Obvious human errors, misspellings etc. are corrected by the National Biodiversity Data Centre during digitisation and are clearly logged in this file.

The national database itself is accompanied by a separate database containing metadata (see data standards within the National Vegetation Database, page 15) on each of the collated digitised datasets. The National Vegetation Database is securely backed up on internal and external servers maintained by the National Biodiversity Data Centre.

Status in 2010

As of September 2010, there are approximately 21,000 relevés in the National Vegetation Database. These relevés are collated from a total of 103 surveys. The current distribution of relevés within the National Vegetation Database can be seen in Figure 2. They are distributed across the Republic, but the areas best represented are The Burren, Co. Clare and Connemara, Co. Galway. 95% of the relevés within the database are independent relevés, with the remainder coming from nested or permanent plots. All relevés included in the database are dated and geo-referenced.

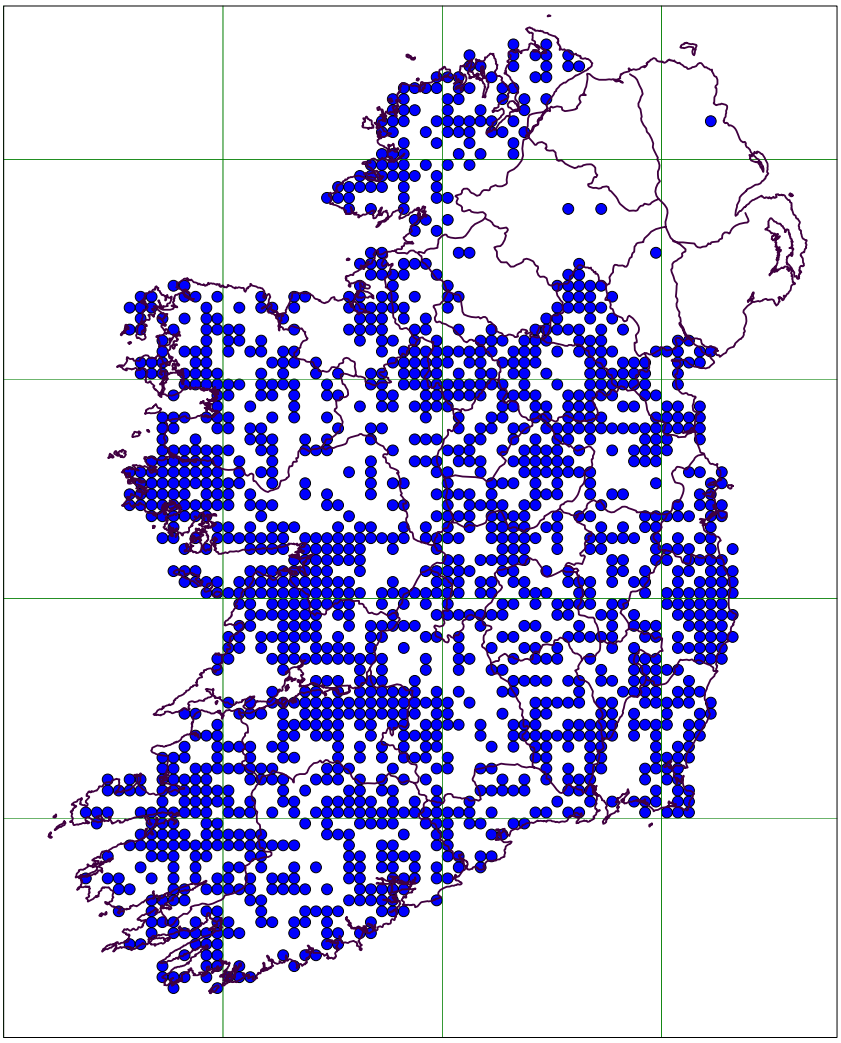


Figure 2: Map of current relevé distribution in the National Vegetation Database, (September 2010). Map is drawn at the 5km^2 level.

To date, the bulk of datasets/surveys digitised have been sourced from reports commissioned by the National Parks and Wildlife Service, and post graduate studies from third level institutions, chiefly University College Dublin, National University of Ireland, Galway and Trinity College Dublin. The database is currently restricted to the Republic of Ireland, and relevés have not been actively sourced from Northern Ireland.

A sizeable number of relevés of peatland, grassland, coastland and woodland vegetation are currently included within the National Vegetation database (Figure 3). Vegetation types that have not been covered adequately to date are: springs, swamps, marsh, lowland heath, freshwater fen, dune slacks, shingle/gravel banks, vegetation of open habitats, (e.g., weed communities.). However, there are relevé sources still to be incorporated into the database that may fill some of these gaps.

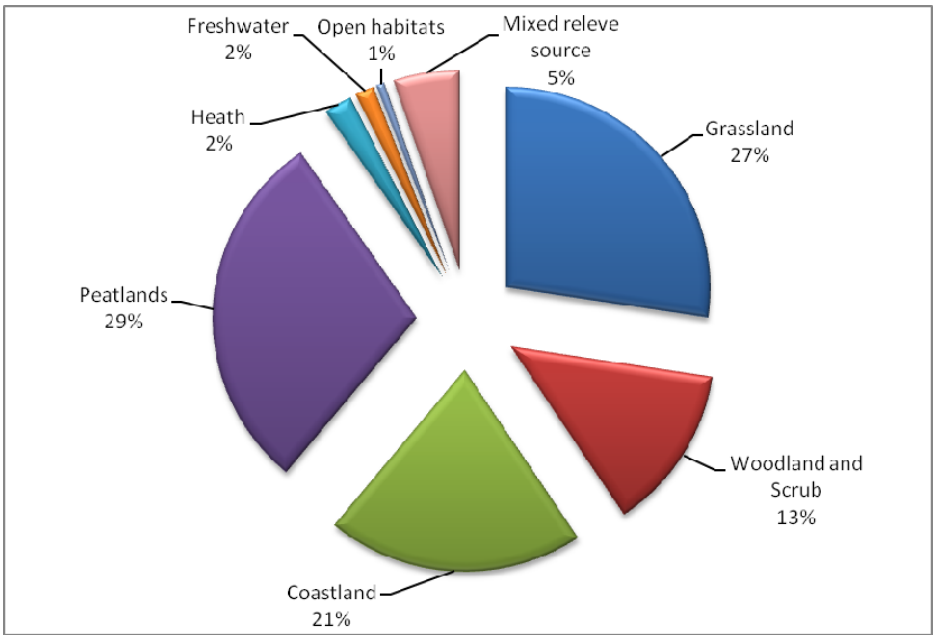


Figure 3: Pie chart showing the % distribution of relevés in the National Vegetation Database by broad habitat type (September 2010). Mixed relevé source refers to surveys that contain relevés from a range of habitat types.

The distribution of relevés currently included in the National Vegetation Database show a good temporal spread, in line with the history of vegetation science in Ireland. Almost 60% have been collected since 1990 (see Figure 4).

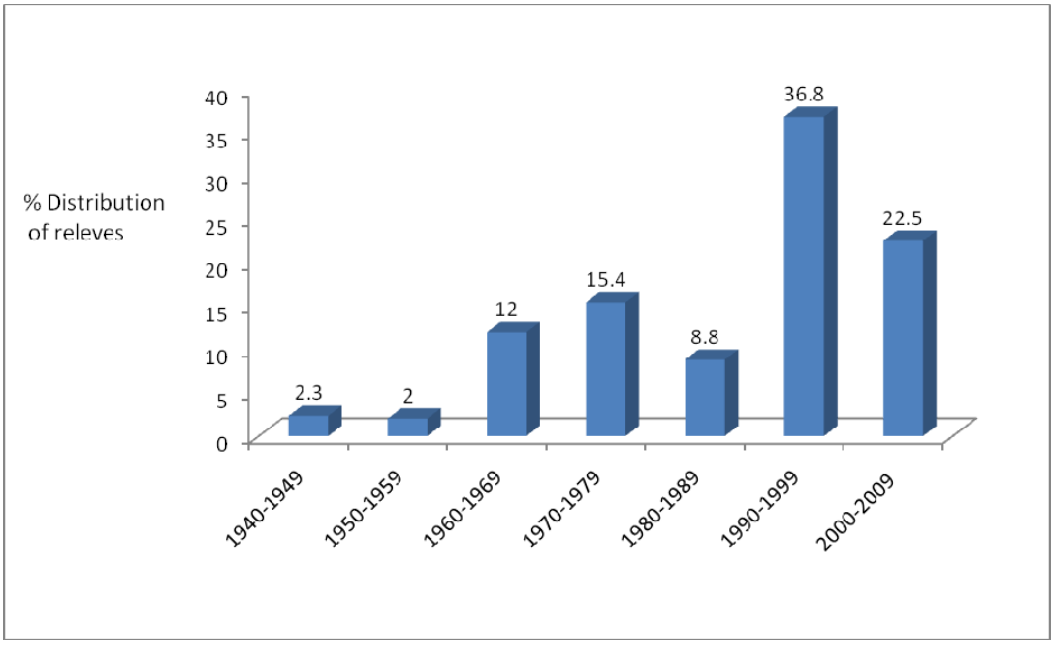


Figure 4: Bar chart showing the % distribution of relevés in the National Vegetation Database by collection date (September 2010).

The National Vegetation Database is accompanied by an active project website, (http://nationalvegetationdatabase.biodiversityireland.ie/) which was launched in August 2008. The website provides background information to the project, along with an up-to-date bibliography of vegetation sources currently in the National Vegetation Database. It provides guidelines and

downloadable resources for the collection and storage of vegetation data in Ireland, including detailed information and advice on the use of Turboveg.

The value of National Vegetation Database at present

In parallel to developing the National Vegetation Database, the National Biodiversity Data Centre has worked to ensure standardisation and best practise in the collection and storage of vegetation data in Ireland. The National Vegetation Database website provides guidelines and extensive resources for Irish researchers who are collecting vegetation data. The Data Centre has worked with the Turboveg developer to optimise the use of the software for the storage of Irish vegetation data, and also run free training courses on the storage and management of vegetation data in Ireland.

The National Vegetation Database contributes large volumes of species data to the National Vascular Plant Database and the National Bryophyte Database. In August 2009, the first batch of 9000 relevés contributed over 100,000 plant and bryophyte species records. These records have been made available to the Botanical Society of the British Isles. The next batch of relevés will be extracted on completion of the vegetation data capture phase and are expected to deliver an additional 150,000 records.

Since establishment, the National Vegetation Database has been providing access to historical information to help direct and inform current habitat surveys, and to allow researchers to more effectively collaborate and formulate research questions. It has also been providing data to European Initiatives such as SynBioSis Europe, allowing us to become part of a wider Europe and to contribute to, and benefit from, shared knowledge and expertise.

The value of the National Vegetation database in the future

When the historical data capture phase is complete, it is expected that there will be in excess of 25,000 relevés in the National Vegetation Database. This figure should increase to over 28,000 due to ongoing national habitat surveys being carried out by the National Parks and Wildlife service over the coming 5 years. Each relevé provides detailed information about the plant community present at a known point in time and from a traceable location. The National Vegetation Database, therefore, provides an important baseline dataset for Ireland and a facility to track and monitor changes in Irish vegetation. It will be held and maintained by the National Biodiversity Data Centre for these purposes.

Importantly, the National Vegetation Database creates a core building block from which a future national vegetation classification system can be developed. A vegetation classification system for Ireland would allow us to accurately describe our vegetation resource and provide sound scientific advice for nature conservation, particularly in protected site selection. The British National Vegetation Classification (NVC) was based on 35,000 sample units (Rodwell, 2006) which equals 1 per 656ha. Currently the Irish National Vegetation Database greatly exceeds this number (1 per 330ha), although it will need to be analysed for key gaps before such a classification system can be developed. A future national vegetation classification system should complement the National Habitat Classification System (Fossitt, 2000) and will incorporate the vegetation classifications that are being developed through the current national habitat surveys being commissioned by the NPWS (e.g., Perrin *et al.*, 2006; Perrin *et al.*, 2010).

On completion of the digital capture of existing vegetation data, the information in the National Vegetation Database can be used to create map layers showing the distribution of habitats and vegetation communities in Ireland. This will contribute valuable information to a future national habitat map.

The National Vegetation database also has the potential to assist with reporting on implementation of the Habitats Directive (Article 17). For reporting on priority habitats under the EU Habitats Directive [92/43/EEC], standardised positive and negative indicator species are used to identify habitats and provide information on the quality of the habitat at a particular location. Relevés within the database can be searched for these discrete species assemblages, and may help to identify new sites.

The National Vegetation Database will also contribute a core building block towards an integrated information management system for landscape, habitat and vegetation data in Ireland in the future (see SynBioSis concept below).

Reporting at a European level on the EUNIS classification system will be required in the future. Storing the plant community level information in the National Vegetation Database will make it relatively straightforward to apply the EUNIS system to the Irish dataset in the future, and assist in identifying areas under that Pan-European vegetation classification system.

The wider context

The establishment of a vegetation database is an important resource at national level, but it also has the potential to form part of wider European initiatives. The European Vegetation Survey has set common data standards for the provision of phytosociological information about plant associations, and has resulted in a comprehensive European overview of vegetation alliances and classes. It has encouraged national programmes of vegetation surveying and has developed an electronic network for data exchange.

SynBioSis Europe was initiated by the European Vegetation Survey and is a powerful information system that is being developed for the evaluation and management of plant species, vegetation type and landscape data. SynBioSis (Syntaxonomical Biological System) was first developed as a national information management system in The Netherlands, with their national vegetation database at its core. Turboveg was designed for the input, processing and presentation of the phytosociological data. Since then Turboveg has been installed in more than 30 countries, and it is now central to the vegetation component within SynBioSis Europe.

SynBioSis Europe is intended to enhance the capacity of environment agencies and others to manage and interpret information on species, vegetation and landscape at the national and European level, and functions as a network of databases related through web services. It brings national Turboveg databases together with a European checklist of plant species, a comprehensive European overview of vegetation alliances and classes, and published maps of European vegetation. At the national level, the SynBioSis model can similarly be used to inform national conservation programmes.

Species data held within SynBioSis Europe include general descriptions (including author citations, synonyms and pictures), information on attributes (like life forms, indicator values, dispersal types), country and grid based distribution patterns, and details on conservation status (Habitats Directive designations, Red Lists). On the vegetation level SynBioSis Europe uses the consensus of European

vegetation types (Rodwell *et al.*, 2002). For each vegetation unit information is provided on general descriptions (phytosociological synonyms, pictures and references), species composition (including vegetation tables), structure and dynamics, ecology, geographic distribution, and conservation status. For the categorisation of landscape types in SynBioSis Europe, the Map of Natural Vegetation of Europe is used as the base. Each landscape type is documented by a general description, information on composition and structure (plant communities, diagnostic and dominant plant species, land use, replacement communities), ecology, geographic distribution, and conservation status.

The pulling together of this level of information makes SynBioSis Europe a powerful tool that will enable partners to access data and information from across Europe and to use this information in nature conservation. From a vegetation perspective, it is an important response to the challenge of integrating vegetation information with knowledge from other disciplines.

DATA STANDARDS WITHIN THE NATIONAL VEGETATION DATABASE

Data standards

The National Vegetation Database contains Irish vegetation sampling units based on a percentage cover abundance scale (e.g., Braun Blanquet, Domin). Relevés collected using the DAFOR scale are not accepted into the database. The vast majority of relevés are independent, although nested and repeat permanent plots are accepted (and clearly labelled within the database). Relevés currently in the National Vegetation Database vary in size from 10cm² to 20m². To ensure data quality, usefulness, and traceability, the following information is mandatory for all relevés included:

- Cover abundance scale used
- Date
- Relevé area (m²)
- Grid reference
- Author name

All additional information collected with each relevé is accepted and stored. The Data Centre has developed standardised data fields to facilitate capture of this information and to allow comparison across surveys in the future. Surveys digitised within the Centre are stored using these standardised data fields, and the fields are made available for all researchers carrying out current or future vegetation surveys in Ireland (Appendices I, II, and III).

Taxonomic standards

Prior to 2008, the Turboveg installation CD supplied to Ireland contained a British based taxonomic dictionary called '*Britain2006*'. This dictionary was not synonymised, and proved inadequate for the accurate capture of Irish vegetation data. In 2008 the National Botanic Gardens supplied an Irish plant checklist, '*Ireland2008*' for use within Turboveg. This checklist includes vascular plants, bryophytes, lichens and charophytes; and incorporates all known synonyms that have been used in Ireland. Historical data for digitisation often contains taxonomic names that are no longer valid. If a synonym is entered into Turboveg it will indicate that this taxon is no longer valid; and how it should be correctly entered, based on the National Botanic Gardens checklist. This allows Irish vegetation data to be accurately captured in a standardized format, and does not rely on the taxonomic expertise of the individual(s) carrying out the digitisation.

All data held in the National Vegetation Database is based on this taxonomy. Existing Turboveg databases that have been compiled using other checklists are incorporated into the system, but are updated to follow '*Ireland2008*'.

Ireland2008 is a composite list that combines four separate checklists:

1. **Vascular plants, native and alien, list for Ireland; National Botanic Gardens, Glasnevin 2008.**

   This list has been constructed from diverse sources, chief amongst them:

   - SCANNELL, M.J.P and SYNNOTT, D.M. (1987) *Census Catalogue of the Flora of Ireland*. Clar de Phlandaí na hÉireann. 2nd. edition. Stationery Office, Dublin.

   - PRAEGER, R.L.I. (1901). Irish Topographical Botany. *Proceedings of the Royal Irish Academy* 23 (3rd. series, 7): 1-410.

   Other sources include the on-line Botanical Society of the British Isles database. Please note that common spelling errors are also included as synonyms.

2. **Bryophytes, native and alien, list for Ireland; National Botanic Gardens, Glasnevin 2008.**

   This list has been derived from the data presented in:

   - HOLYOAK, D.T. (2003) *The distribution of bryophytes in Ireland*. Dinas Powys, Vale of Glamorgan: Broadleaf Books.

   The red data categories have been taken from:

   - HOLYOAK, D.T. (2006) Progress towards a species inventory for conservation of bryophytes in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, VOL. 106B, NO. 3, 225-236.

3. **Checklist of Lichens of Great Britain and Ireland London: British Lichen Society 2002**

   An Irish lichen list is not currently available, therefore a checklist is sourced from:

   - COPPINS, B.J. (2002) *Checklist of Lichens of Great Britain and Ireland*. London: British Lichen Society.

4. **Characeae list for Ireland; National Botanic Gardens, Glasnevin 2008.**

   This list is based upon:

   - BRYANT, J.A., STEWART, N.F. and STACE, C.A. (2002) A checklist of Characeae of the British Isles, *Watsonia* 24: 203–208.

The Irish checklists are available on the National Botanic Gardens website:
http://www.botanicgardens.ie/herb/census/resource.htm

All taxonomic updates to the checklist (*Ireland2008*) are controlled by the National Botanic Gardens. Outside this, the checklist is managed as a working dictionary for the National Vegetation Database by the Data Centre. The most recent version of *Ireland2008* is available for download on the project website along with instructions on how to install it in Turboveg. From February 2008 Turboveg installation CD's supplied to Ireland come with *Ireland2008* included as standard.

Data quality

Data quality is a challenge in the creation of a national database that draws data from a range of sources. To ensure the quality of the data, relevés must be supplied with the mandatory information (see page 15) and are only accepted if the data can be validated.

Data from a published source is accepted as validated. Data from unpublished governmental reports are assumed to have been validated by the funding organisation (e.g., NPWS, NIEA). Data from a third level institution is assumed to have been validated by the supervisor of the postgraduate student. All other data is assessed by a validation committee before being accepted into the National Vegetation Database. This committee is a subset of the National Vegetation Database advisory group, but includes additional relevant taxonomic experts as required.

During digitisation obvious human errors are corrected. However, **all** changes made to the raw data or assumptions that are made with respect to a particular relevé, are clearly tracked through the data entry log system. All surveys in the National Vegetation Database are accompanied by a data entry log. The original data, along with the necessary changes are clearly recorded in this log. This means if a query arises at a later stage, all changes to either ecological or species data can be accounted for.

Metadata required with each survey

Metadata is required with each survey accepted into the National Vegetation Database. The metadata is held in a separate database maintained by the National Biodiversity Data Centre. Metadata templates (Table 2) are available for download from the National Vegetation Database website at http://nationalvegetationdatabase.biodiversityireland.ie

[NB Additional metadata is required for vegetation data collected as part of NPWS surveys.]

Table 2: Sample metadata file held by the National Biodiversity Data Centre. Grey fields should be completed by the dataset contributor.

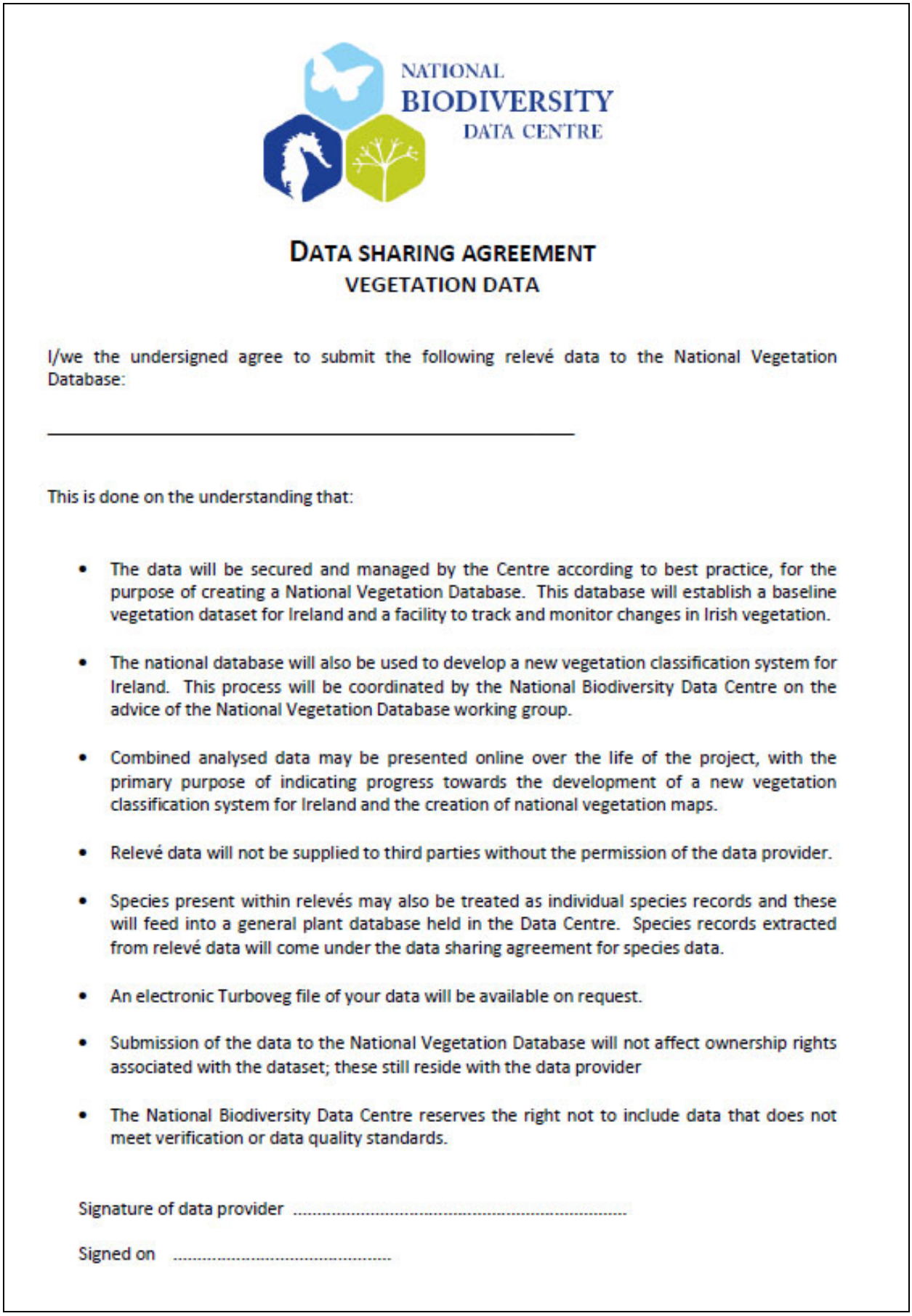
Data Item	Description (example)
Title of the dataset	Biomar survey of Irish Machair sites
Dataset contributor	National Parks and Wildlife Service
Contact details of dataset contributor	Naomi Kingston, NPWS, Ely Place, Dublin 2.
Source	Biomar Survey of Irish Machair Sites (Crawford,1996)
Description	1450 relevés collected within Irish machair sites in 1996
Purpose of data capture	Research survey carried out by NPWS
Relation	One component of a larger Biomar survey
Geographic coverage	Counties: Donegal, Sligo, Mayo, Galway & Clare
Survey dates (start to end date)	5.6.1996-22.8.1996
Status of dataset	Complete and published as an NPWS report
Data quality	Survey was carried out by NPWS staff
Reference source if published	Unpublished NPWS Report: Crawford, I. et al. (1996). Biomar Survey of Irish Machair Sites.
Source format	Paper report and MS word document
Data rights	Property of NPWS
Dataset identifier	NVD006 (code assigned in the Data Centre)
Type	Turboveg database v2.73
Publisher	National Biodiversity Data Centre
Language	English, Latin
Turboveg database creator	Edwin Wymer, National Biodiversity Data Centre
Date of database creation	August 2007
Technical details	Database originally created in Turboveg v.2.51, species list used 'Britain2006'. Updated to species list 'Ireland2008' in 2008 (Úna Fitzpatrick)
NBDC staff contact	Úna Fitzpatrick
Metadata Standard	Dublin Core Metadata Standard and ISO 19115

Data sharing agreement

In consultation with the National Parks and Wildlife Service, the National Biodiversity Data Centre has produced a data sharing agreement to cover data submitted to the National Vegetation Database (Figure 5).

This should be read and signed by all data contributors. The purpose of this document is to reassure the owner of submitted vegetation data that their relevés will only be used for the purposes stated in the data sharing agreement. Submission of data does not affect their ownership rights and the data will not be given to any third party without permission.

The data sharing agreement is available for download from the National Vegetation Database website at http://nationalvegetationdatabase.biodiversityireland.ie



NATIONAL BIODIVERSITY DATA CENTRE

DATA SHARING AGREEMENT
VEGETATION DATA

I/we the undersigned agree to submit the following relevé data to the National Vegetation Database:

_____

This is done on the understanding that:

- The data will be secured and managed by the Centre according to best practice, for the purpose of creating a National Vegetation Database. This database will establish a baseline vegetation dataset for Ireland and a facility to track and monitor changes in Irish vegetation.
- The national database will also be used to develop a new vegetation classification system for Ireland. This process will be coordinated by the National Biodiversity Data Centre on the advice of the National Vegetation Database working group.
- Combined analysed data may be presented online over the life of the project, with the primary purpose of indicating progress towards the development of a new vegetation classification system for Ireland and the creation of national vegetation maps.
- Relevé data will not be supplied to third parties without the permission of the data provider.
- Species present within relevés may also be treated as individual species records and these will feed into a general plant database held in the Data Centre. Species records extracted from relevé data will come under the data sharing agreement for species data.
- An electronic Turboveg file of your data will be available on request.
- Submission of the data to the National Vegetation Database will not affect ownership rights associated with the dataset; these still reside with the data provider
- The National Biodiversity Data Centre reserves the right not to include data that does not meet verification or data quality standards.

Signature of data provider .....

Signed on .....

Figure 5: National Biodiversity Data Centre Data sharing agreement form.

GUIDELINES FOR THE COLLECTION OF VEGETATION DATA IN THE FIELD

Field recording card

In an attempt to ensure that standardisation is applied to the present and future collection of vegetation data in Ireland, a simple standardised field recording card has been created that is compatible with the National Vegetation Database (Figure 6). This card has been developed in consultation with National Parks and Wildlife Service and attempts have been made to make it compatible with the NPWS rare plant recording card.

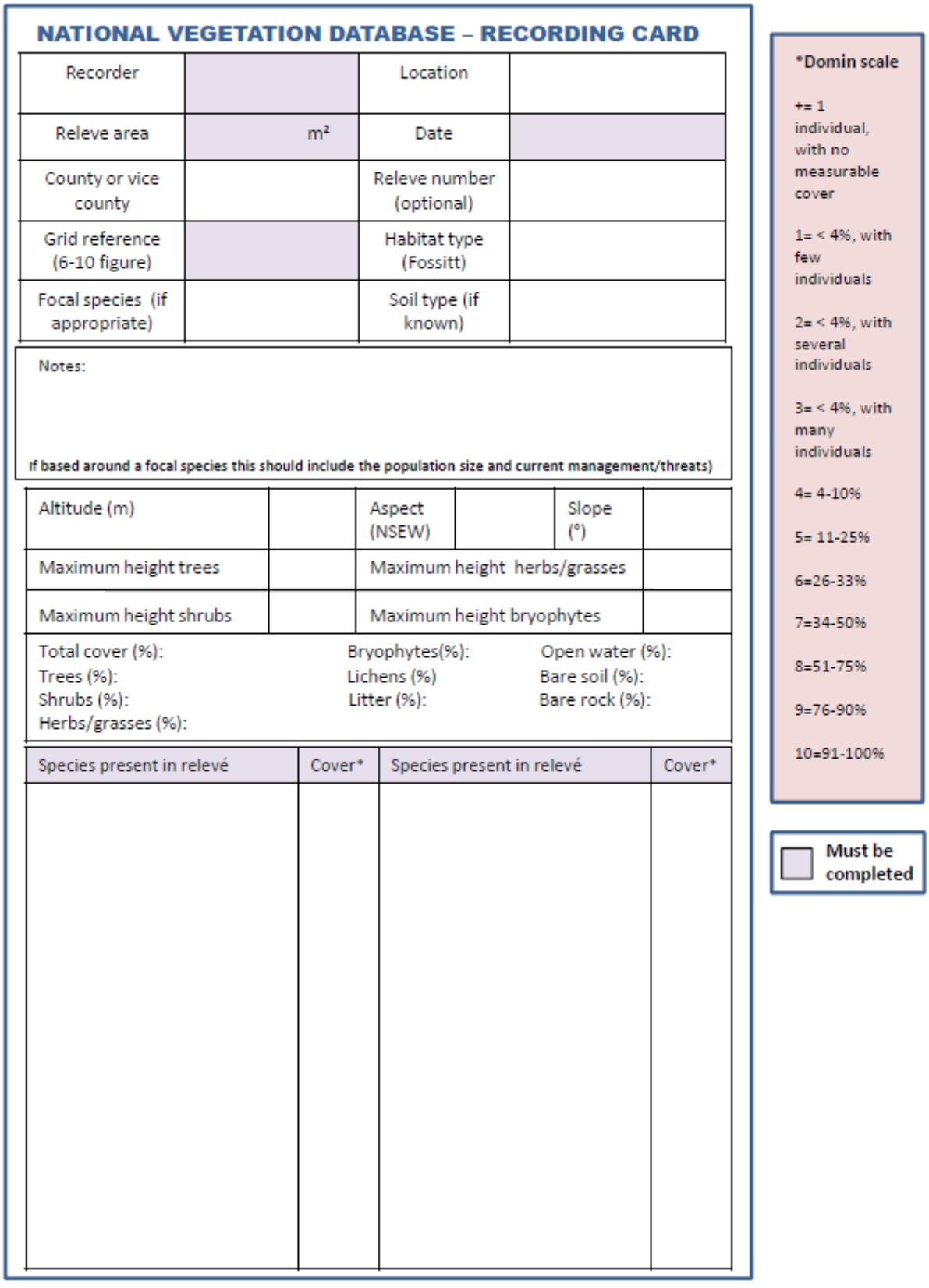
The card is a simple guide for those new to vegetation surveying, constructed to stress the minimum mandatory fields required, and to encourage the use of the DOMIN cover abundance scale. It is assumed experienced surveyors use this basic structure in the field, whether in card form or within a portable recording device, with additional customised data fields to suit the habitat being studied.

Turboveg CE

It is recommended that future national level vegetation surveys should be carried out using mobile recording devices with Turboveg CE installed (compatible with MS Windows Mobile/PocketPC), to directly capture data digitally in the field. This removes the need for subsequent digitisation to Turboveg which can be laborious (Perrin *et al.*, 2010). Details on Turboveg CE can be obtained from the Turboveg website (http://www.synbiosys.alterra.nl/turboveg/). Training surveyors in the use of Turboveg software in the field would be greatly beneficial as it would help standardize field recording methods and plant nomenclature usage within Irish vegetation studies.

The National Biodiversity Data Centre provides guidelines and advice for field ecologists carrying out vegetation surveys, but it is essential that third level botany students involved in vegetation science are tutored in these methodologies so as to allow greater consistency between vegetation datasets, thus making examination, monitoring and collating of data easier in the future.

Figure 6: Sample standardised recording card.



NATIONAL VEGETATION DATABASE – RECORDING CARD

Recorder		Location	
Releve area	m²	Date	
County or vice county		Releve number (optional)	
Grid reference (6-10 figure)		Habitat type (Fossitt)	
Focal species (if appropriate)		Soil type (if known)	

Notes:

If based around a focal species this should include the population size and current management/threats)

Altitude (m)		Aspect (NSEW)		Slope (°)	
Maximum height trees		Maximum height herbs/grasses			
Maximum height shrubs		Maximum height bryophytes			

Total cover (%):	Bryophytes(%):	Open water (%):
Trees (%):	Lichens (%)	Bare soil (%):
Shrubs (%):	Litter (%):	Bare rock (%):
Herbs/grasses (%):		

Species present in relevé	Cover*	Species present in relevé	Cover*

*Domin scale

+= 1 individual, with no measurable cover

1= < 4%, with few individuals

2= < 4%, with several individuals

3= < 4%, with many individuals

4= 4-10%

5= 11-25%

6=26-33%

7=34-50%

8=51-75%

9=76-90%

10=91-100%

Must be completed

GUIDELINES FOR THE STORAGE AND MANAGEMENT OF VEGETATION DATA

How vegetation data should be digitally stored

When vegetation data is collected in Ireland it should ideally be stored in the most up to date version of the Turboveg software available, with the *Ireland2008* dictionary installed. The guidelines set out within this manual should be followed when creating a Turboveg database, so that it is compatible with the National Vegetation Database. This would ensure that, where appropriate, Irish vegetation data can be incorporated into the National database, and contribute towards a future National vegetation classification system.

Where it is not possible to use Turboveg it is recommended that a standardised excel template is used to store and manage vegetation data collected in the field (see table 3). This template has been formatted for compatibility with Turboveg.

Turboveg

Turboveg was designed to record, store and manage phytosociological vegetation data, and is available as both a PC desktop and MS Windows Mobile version. The software was developed by Stephen Hennekens (Alterra, Wageningen, The Netherlands) and is now installed in more than 30 countries. In 1994 it was accepted as the standard computer package for the European Vegetation Survey and it now forms a central component of SynBioSis Europe. The program JUICE was developed in the Czech Republic in 1998 (Tichy, 2002) for the classification and analysis of vegetation data. It is optimised for use in association with Turboveg.

THE USE OF TURBOVEG SOFTWARE

Turboveg is recommended for the following:

- Recording: TurbovegCE software can be used in recording of vegetation data in the field
- Storage: Relevé data entered manually or imported from data files.
- Selection: Can build queries by selecting species and/or ecological data
- Export: Can format and export data to other programs for further analyses.

Compatible programs

Turboveg data can be exported directly or indirectly to various computer programmes for further analyses. The more common programmes are listed below:

- ArcGIS - ArcGIS can be used on a desktop or in the field via a mobile device enabling GIS data analysis and modelling (commercial software).
  Website**:** www.esri.com/software/arcgis/index.html
- ArcView - ArcView is geographic information system (GIS) software, to manage and analyze geographic data (commercial software).
  Website: http://www.esri.com/software/arcgis/arcview/index.html
- CANOCO – CANOCO is a tool for ordination of ecological data using regression and permutation methodologies (ter Braak 1986). The latest version is CANOCO 4.5 (commercial software). Website: www.canoco.com
- DMAP - Used for mapping of species, vegetation communities or relevé distribution developed by Alan Morton (commercial software). Website: http://www.dmap.co.uk/
- Google Earth - Can be used to map GIS data (free and commercial software available). Website: http://www.google.com/earth/explore/products/desktop.html
- Juice - Designed as a Microsoft Windows application for editing, classification and analyses of phytosociological tables or other ecological data (Tichy, 2002) (freeware). Website: http://www.sci.muni.cz/botany/juice/
- Lotus123 - Lotus 1-2-3 is a spreadsheet programme from Lotus Software (commercial software). Website: www.ibm.com/software/lotus/products/123/
- Megatab - A classification and ordination program for vegetation data (Hennekens & Schaminée 2001) (commercial software).
- MS Access - Microsoft Access is included in the Microsoft Office package (commercial software). Website: http://office.microsoft.com/en-us/access/
- MS Excel - Microsoft Excel is included in the Microsoft Office package (commercial software). Website: http://office.microsoft.com/en-us/excel/
- MULVA - MULVA-5 is a statistical tool for plant ecology (Wildi & Orlóci, 1996) (freeware): Website: http://www.wsl.ch/land/products/mulva/

- PC-ORD - An integrated system for multivariate analysis of ecological data (McCune & Mefford, 2006) (commercial software).
  Website: http://pcord.home.comcast.net/~pcord/pcord/PBooklet.pdf
- Syntax - Computer program for multivariate data analysis (Podani, 1994) (commercial software). Website: http://ramet.elte.hu/~podani/subindex.html
- Twinspan - Two Way INdicator SPecies ANalyses, TWINSPAN is a program for classifying species and samples in to an ordered two-way table of their occurrence (Hill, 1979) (freeware). A windows version is available (Wintwin). Website: http://www.canodraw.com/wintwins.htm

System Requirements

- 486-processor with 8 Mb RAM (Pentium- processor with 16 Mb RAM recommended).
- Screen resolution of 800 x 600 pixels minimum.
- Supported operating systems consist of Windows (95, 98, ME, NT, XP, 7).

Website

- http://www.synbiosys.alterra.nl/turboveg/

Advantages of using Turboveg for recording and storing vegetation data

- Secure digital storage of vegetation data in software that is continually maintained and updated
- Data can be easily managed, manipulated, and assessed using basic statistical functions included within the software
- More consistency in species recording through the use of a standardised taxonomic dictionary. An up-to date Irish species checklist *Ireland2008* is included within the version of Turboveg supplied to Ireland, or for download from:
  http://nationalvegetationdatabase.biodiversityireland.ie/
- Filters to format data, allowing selected relevés to be easily exported for further analysis with various packages (e.g. MS Access, Twinspan, Canoco, PC-ORD, Mulva, Syntax-5, MS Excel, Juice, ArcView, ArcGIS, Google Earth).
- Any data collected can be readily transferred between individuals, and can be supplied directly to the National Vegetation Database, if appropriate.
- Perrin *et al.*, (2010) point out that using Turboveg CE in the field significantly reduces the amount of post-survey work and potential for data entry error.

The Turboveg model

Information is stored within the Turboveg programme as follows:

1. Attributes - This form is filled in initially when creating a new Turboveg file to hold information collected within a vegetation survey. It contains details of the dataset's name, relevé number range and specifies the taxonomic dictionary used.

2. Header data - For each relevé collected within the survey, this form is used to store the ecological data collected, as well as any additional information such as recorder name.
3. Species Data - For each relevé collected within the survey, this form is used to store the species list recorded, along with the cover abundance values.

Creating a Turboveg database that is compatible with the National Vegetation Database

1. Relevé data must meet the minimum requirements - The data must include a cover abundance scale, date, relevé area (m^2), grid reference, and recorder.
2. The standardised Irish checklist *Ireland2008* should be used - If the Turboveg software was obtained in Ireland after 2008, this will be the default dictionary within the programme. If the software was obtained before 2008, the updated *Ireland2008* dictionary will need to be installed. This can be downloaded from the National Vegetation Database website along with instructions on how to install it: http://nationalvegetationdatabase.biodiversityireland.ie/
3. Standardised data fields created within the National Vegetation Database should be used where possible. Tables of existing data fields can be accessed from the National Vegetation Database website (also, see Appendices I, II and III).
4. Background metadata should be stored with the Turboveg database. Template metadata files (see table 2) are available for download on the National Vegetation Database website.

Step by step guide to setting up Turboveg file

A comprehensive Turboveg user's manual is provided on the Turboveg website (http://www.synbiosys.alterra.nl/turboveg/tvwin.pdf). The simple step by step guide presented here provides instruction for beginners on some of the key tasks involved in creating a Turboveg database in Ireland. **It is not intended to replace the manual**.

1. Manual input of data in to Turboveg

If vegetation data was recorded manually on relevé cards, it can manually digitised as described in the steps below.

<u>To create a new Turboveg file:</u>

Open Turboveg.

Database menu:	Click 'New'	To set up the dataset's attributes, fill in the database name, relevé range, and select *Ireland2008* dictionary.

<u>Set up data fields needed to store your environmental data:</u>

Database menu:	Click 'modify structure'	Create each additional data field required that is not already a default one. (Refer to appendices II and III or go online to check out the latest list of data fields created for the NVD). Add field name, character or number type, length of field and decimal place if required. Click 'Add' for each field entered and, click 'Rebuild' when entry is complete.

Entry of environmental and vegetation data:

Open a relevé:	Click new relevé symbol	Fill in details with relevant remarks if necessary on the header data forms. This is where ecological and environmental data is stored for each relevé. Cover scale is a compulsory field, click on question mark to select a cover scale code.
	Click 'Save'	Species input form will appear.
Add species:		Type in 1st three letters of genus and species. Possible names will appear in the species box, select the species required. Note: Species names that appear in blue are synonyms that should be updated to the correct valid name indicated on the top of the species text box. Enter % layer covers if required and cover abundance value, click 'Add'.
Modify/remove species:		Can be done by selecting a species from the entered species list and clicking 'modify' or 'remove'.
Adding remarks:	Click 'Remarks'	Type in details. This 'remarks' data field is the same as that on the header data form.
Adding additional relevés		
	Click new relevé symbol	Choose 'yes' or 'no' to copying the header data from the previous relevé and edit where necessary.

2. Backing up and exchanging data

Backing up Turboveg files

Use this function to backup your Turboveg files and store them in a secure external location.

Database menu:	Click backup/restore.	Select Backup relevé database Select the database for which back-up is required. Click 'OK'. Select a destination file for saved data, Click 'OK'.

Adding or restoring a Turboveg file

This function is recommended for restoring a Turboveg file previously saved in a different location.

Database menu:	Click backup/restore	Select 'restore'. Select which database is to be restored/added to Turboveg. Press 'OK'.

Exchanging TV files

The backup and restore function is recommended for the exchange of Turboveg files between users. Alternatively, you can share Turboveg files using the XML option but be careful if you use pop ups as all information may not be transferred.

Database menu:	Click 'Open'	Select the survey you want to exchange.
Select menu:		Select all the relevés in the current database.
Export menu:		Select an appropriate format required for the exported data, (example: Standard XML file).
		Select a destination file for the saved data, Click 'OK'.

Note: If you receive an XML file you will first need to create a new blank database before importing.

Importing of Data from a MS Excel File

Vegetation data is often recorded on to excel spreadsheets, a typical example can be seen in Table 3. This data can be formatted and imported directly in to Turboveg. The instructions on importing excel files in to Turboveg are found in the official user's manual on the Turboveg website. However, it is felt that these instructions can be difficult to follow for first time users. The purpose of the following step by step guide is to clarify the process.

Preparation of Excel File data

Species data and header data must be imported into Turboveg separately; therefore the MS Excel table of relevé data has to be split in to a species table and a header table in excel before import. Species data must be imported first, followed by header data.

Formatting species data:

1. Copy and paste the species data on to a blank MS Excel spreadsheet (table 4).
2. Remove relevé numbers, headings, and blank columns.
3. The order of each relevé column on the species sheet should correspond to the order of the relevés in the header data to ensure the imported species data is linked to the correct relevé header details.
4. Save the MS Excel species spreadsheet before proceeding.

Formatting header data:

1. Copy and paste the header data on to a new Excel spreadsheet
2. When pasting, use 'paste special' and 'transpose data' so that header titles are in a row on the top of the table, rather than being in a column as originally arranged (Table 5).

   Note: Header titles must be on the top row.
3. Delete any blank rows
4. Insert a relevé number column to left of table and number the relevés as they are to appear in the Turboveg dataset

   Note: This number will act as a 'key field' that is unique to each relevé in any dataset entered. Make sure this number has not been used within this database previously.
5. Re-format date by removing separators, for example from 04/07/1990 to 19900704.

Table 3: Example of an excel spreadsheet showing a typical layout of environmental and vegetation data.

NVD relevé number	10000	10001	10002	10003	10004	10005	10006
Relevé No.	1	2	3	4	5	6	7
Country code	IE	IE	IE	IE	IE	IE	IE
Cover abundance scale	Braun-Blanquet	Braun-Blanquet	Braun-Blanquet	Braun-Blanquet	Braun-Blanquet	Braun-Blanquet	Braun-Blanquet
Date	04/07/1990	04/07/1990	04/07/1990	04/07/1990	04/07/1990	04/07/1990	04/07/1990
Quadrat size (m²)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Altitude (m)	150	150	150	100	100	100	100
Cover total (%)	100	100	100	100	100	100	100
Remarks	This releve recorded on gentle flat terrain	This releve recorded on gentle flat terrain	This releve recorded on gentle flat terrain	This releve recorded on gentle flat terrain	This releve recorded on gentle flat terrain	This releve recorded on gentle flat terrain	This releve recorded on gentle flat terrain
Location	Glenveigh National Park	Glenveigh National Park	Glenveigh National Park	Glenveigh National Park	Glenveigh National Park	Glenveigh National Park	Glenveigh National Park
Habitat type	PB2	PB2	PB2	PB2	PB2	PB2	PB2
Grid reference	C045219	C045220	C044223	C042018	C050230	C050230	C050232
Author's name	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.
Enterer's name	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.	Weekes, L.
Literature source	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
SPECIES DATA							
Menyanthes trifoliata	.	+	+	1	+	+	1
Myrica gale	1	.	1	.	+	1	1
Sphagnum papillosum	+	3	3	3	1	.	3
Calluna vulgaris	1	+	2	2	+	.	.
Erica tetralix	1	1	.	1	.	1	1
Eriophorum angustifolium	2	1	1	1	+	.	1
Molinia caerulea	3	2	2	3	+	2	1
Narthecium ossifragum	1	.	1	1	2	1	1
Rhynchospora alba	1	.	1	2	2	.	2
Schoenus nigricans	2	3	1	1	2	4	1
Cephalozia bicuspidata	+	.	.	+	.	.	.
Odontoschisma sphagni	+	1	+	+	+	.	.
Pleurozia purpurea	+	.	.	.	.	.	+
Sphagnum cuspidatum	+	+	1	1	.	.	2
Sphagnum denticulatum	1	1	.	+	2	1	.
Sphagnum tenellum	+	.	.	.	+	+	.
Sphagnum subnitens	1	+	+	.	1	+	+
Drosera rotundifolia	.	1	.	+	1	+	1
Hypnum jutlandicum	.	+	.	.	.	+	.
Sphagnum capillifolium	.	1	.	.	.	.	.
Polygala serpyllifolia	.	.	+	.	+	.	+
Sphagnum magellanicum	.	.	+	.	.	.	.
Potamogeton polygonifolius	.	.	.	1	2	2	.
Kindbergia praelonga	.	.	.	+	.	.	.
Drosera anglica	.	.	.	.	+	.	+
Drosera intermedia	.	.	.	.	+	1	.
Pinguicula lusitanica	.	.	.	.	+	1	.
Utricularia intermedia	.	.	.	.	1	.	.
Breutelia chrysocoma	.	.	.	.	+	.	.
Sphagnum palustre	.	.	.	.	.	2	.
Zygogonium species	.	.	.	.	.	3	.
Trichophorum cespitosum	.	.	.	.	.	.	+
Aneura pinguis	.	.	.	.	.	.	+
Campylopus atrovirens	.	.	.	.	.	.	.

Table 4: Example of species data separated from header data for import into Turboveg.

Menyanthes trifoliata	.	+	+	1	+	+	1	1	1	2
Myrica gale	1	.	1	.	+	1	1	1	1	2
Sphagnum papillosum	+	3	3	3	1	.	3	2	1	1
Calluna vulgaris	1	+	2	2	+	.	.	.	.	2
Erica tetralix	1	1	.	1	.	1	1	.	2	2
Eriophorum angustifolium	2	1	1	1	+	.	1	2	1	1
Molinia caerulea	3	2	2	3	+	2	1	2	2	2
Narthecium ossifragum	1	.	1	1	2	1	1	+	1	+
Rhynchospora alba	1	.	1	2	2	.	2	2	1	.
Schoenus nigricans	2	3	1	1	2	4	1	3	2	2
Cephalozia bicuspidata	+	.	.	+	.	.	.	+	.	.
Odontoschisma sphagni	+	1	+	+	+	.	.	+	.	+
Pleurozia purpurea	+	.	.	.	.	.	+	+	.	.
Sphagnum cuspidatum	+	+	1	1	.	.	2	+	.	.
Sphagnum denticulatum	1	1	.	+	2	1	.	.	.	.
Sphagnum tenellum	+	.	.	.	+	+	.	.	.	.
Sphagnum subnitens	1	+	+	.	1	+	+	.	1	.
Drosera rotundifolia	.	1	.	+	1	+	1	.	+	1
Hypnum jutlandicum	.	+	.	.	.	+	.	.	.	.
Sphagnum capillifolium	.	1	.	.	.	.	.	.	.	1
Polygala serpyllifolia	.	.	+	.	+	.	+	.	+	+
Sphagnum magellanicum	.	.	+	.	.	.	.	.	.	.
Potamogeton polygonifolius	.	.	.	1	2	2	.	.	.	.
Kindbergia praelonga	.	.	.	+	.	.	.	.	.	.
Drosera anglica	.	.	.	.	+	.	+	1	+	+
Drosera intermedia	.	.	.	.	+	1	.	1	.	.
Pinguicula lusitanica	.	.	.	.	+	1	.	.	.	.
Utricularia intermedia	.	.	.	.	1	.	.	.	.	.
Breutelia chrysocoma	.	.	.	.	+	.	.	.	.	.
Sphagnum palustre	.	.	.	.	.	2	.	.	.	.
Zygogonium species	.	.	.	.	.	3	.	2	3	1
Trichophorum cespitosum	.	.	.	.	.	.	+	.	.	.
Aneura pinguis	.	.	.	.	.	.	+	.	.	.
Campylopus atrovirens	.	.	.	.	.	.	.	.	+	.

Table 5: Example of header data formatted for import into Turboveg.

NVD relevé number	Relevé No.	Country code	Date	Quadrat size (m²)	Altitude (m)	Cover total (%)	Remarks	Location	Hab_type	Grid_code	Aut_name	Ent_name	Lit_source
10000	1	IE	19900704	1.00	150	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C045219	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10001	2	IE	19900704	1.00	150	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C045220	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10002	3	IE	19900704	1.00	150	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C044223	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10003	4	IE	19900704	1.00	100	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C042018	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10004	5	IE	19900704	1.00	100	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C050230	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10005	6	IE	19900704	1.00	100	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C050230	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10006	7	IE	19900704	1.00	100	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C050232	Weekes, L	Weekes, L	Weekes, L. (1989) A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10007	8	IE	19900704	1.00	100	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C049220	Weekes, L	Weekes, L	Weekes, L. (1989). A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10008	9	IE	19900704	1.00	100	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C060232	Weekes, L	Weekes, L	Weekes, L. (1989). A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal
10009	10	IE	19900704	1.00	160	100	This releve recorded on gentle flat terrain	Glenveigh National Park	PB2	C059221	Weekes, L	Weekes, L	Weekes, L. (1989). A Vegetation Survey of Glenveigh National Park & An Taisce Property, Co. Donegal

Import of species data

NB - Species data must be imported first.

Species import:	Create a new TV file (as described previously on page 23). Click 'Import free format species data table' on the import menu. Select the excel file and the species data sheet. The species relevé table appears.
Relevé selection:	Select relevés by clicking on the column containing species and press space bar until all relevés are selected. An '*' will indicate selected relevés. Select the column in which the species are in (usually column 1) press 'Next '.
Translation:	Species will be translated in to species codes from *Ireland2008* dictionary within Turboveg. Any species that are not translated need to be corrected by hand (highlighted in blue). Double click the blue species and type in 1st three letters of genus and species and enter the appropriate updated valid species indicated on top of the species box.
Cover scale:	Select cover scale from drop down menu, click 'Next'.
Cover code translation:	Questions may be asked during cover code translation: *Example 1*: Turboveg may ask to replace ' ' (meaning a blank cell in the species excel sheet) with an 'x' when being imported in to Turboveg. Usually there is no need for this replacement so all blank cells should be ignored by selecting the option 'Ignore all'. *Example 2*: When asked to replace a '2' with a '2', it is necessary to select the option 'Replace all'. This ensures that cover values of '2' are translated in to the Turboveg database as such. Continue until the translation of the cover code is complete.
Species check	**Note:** Not all synonyms are detected and translated in to their updated valid name during the importing process. It is necessary therefore, to check through the imported relevés for possible synonyms and update them.
Update synonyms	There are three methods to update synonyms or change a species entered in error within a Turboveg file:

Method 1: Useful for changing a species only occurring in one relevé within a database.

Open species list of the selected relevé, click the species that needs to be changed.

Click 'Modify'.

Type in species name required and click 'Replace' (Figure 7)

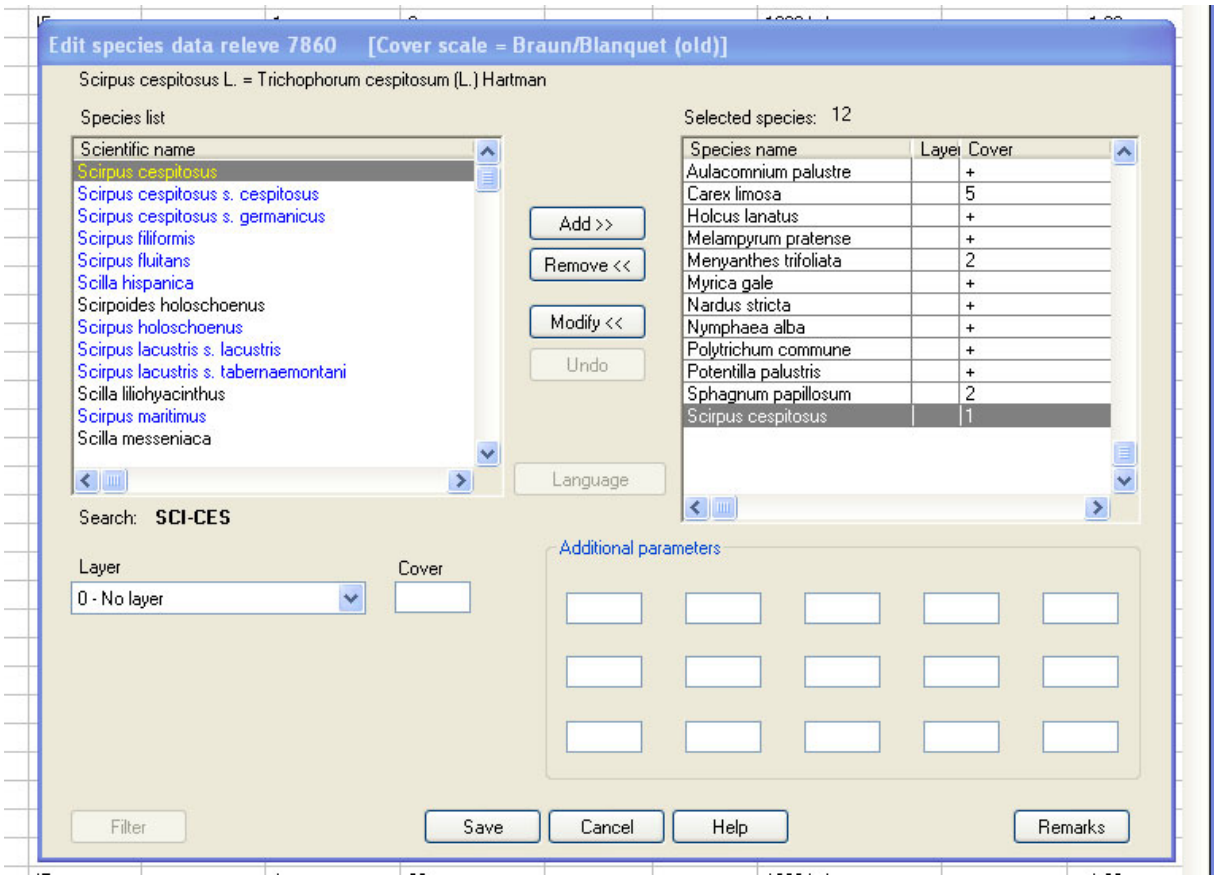


Figure 7: Opened relevé in Turboveg showing species edit box.

Method 2: Useful if the species occurs in many relevés.

In edit menu, select 'Replace species', check the range of relevés is correct (Figure 8).

Click on 'Old' [>>] and type in species that needs to be changed. Then click on 'New' and type in the updated name.

Click 'Replace'. The species will be changed in the range of relevés selected if present.

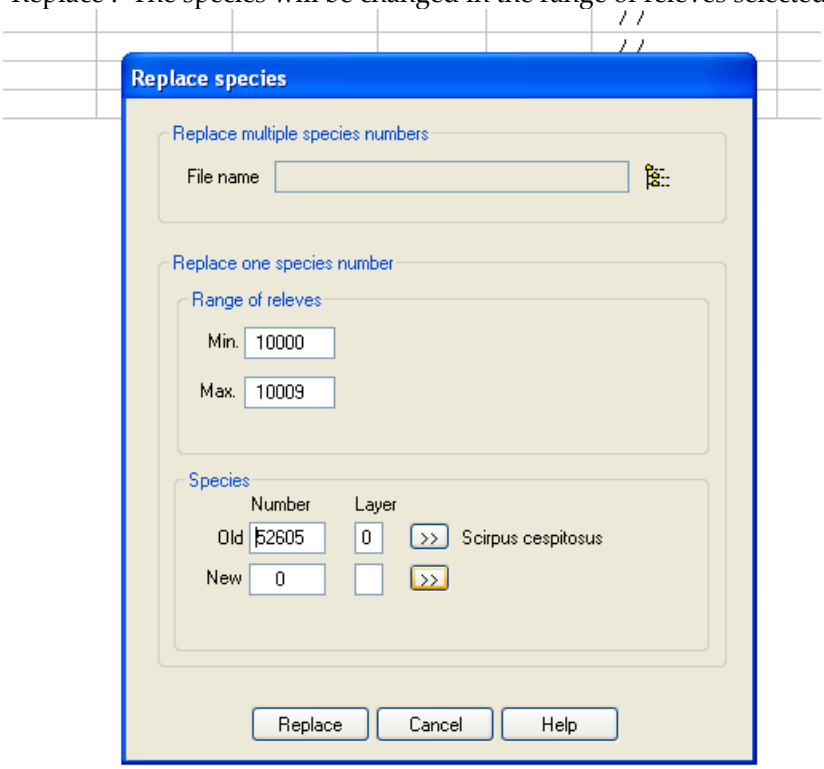


Figure 8: A 'Replace species' box within the edit menu in a Turboveg dataset.

Method 3: Useful when changing all synonyms at once.

In edit menu, select 'replace all synonyms with accepted names' (Figure 9).

This will replace all synonyms in all relevés within the opened dataset

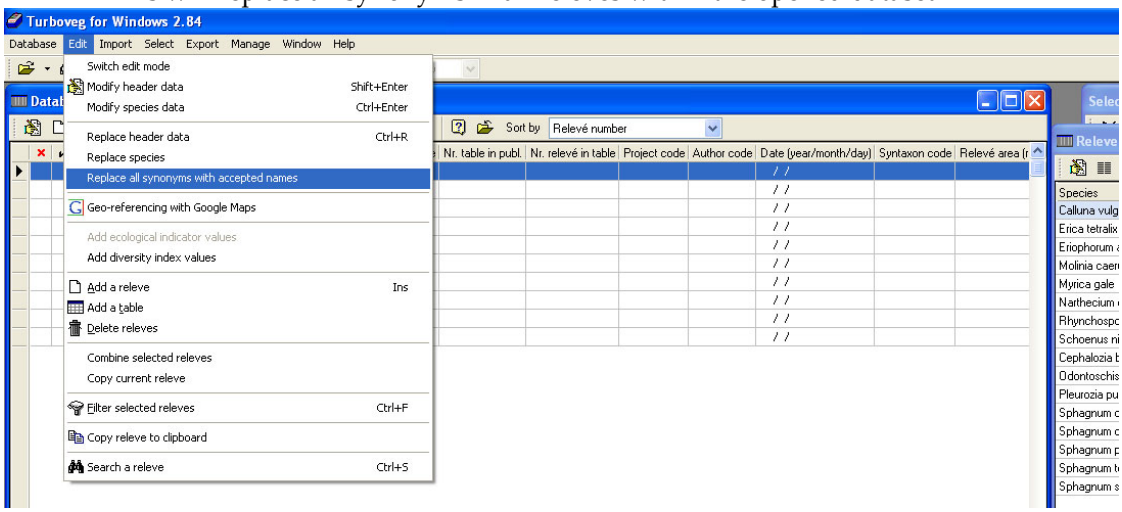


Figure 9: Edit menu within a database in Turboveg.

Import of header data

Header import:	In the database menu in Turboveg, select 'Modify structure' and check that all the data fields have been set up. Click 'Import free format header data table' on import menu. Select the appropriate excel file, and header data spreadsheet The header spreadsheet appears.
Labelling columns:	Click on each data field heading and select a corresponding Turboveg data field from the list that appears.
Key Field:	Make sure that the database relevé number is selected as the key field, this provides a unique number for each relevé within the Turboveg database.
New fields:	Do **not** click 'add new fields automatically', as unlabelled data fields can then be ignored if required. Click 'Complete', the data should now be imported.

If new data fields need to be added after importing, there are two methods:

Method 1: Can be used if data is to be imported from the excel file.

Click on 'Modify structure' in database menu and add new data field.

Go through importing process again only selecting the new data field to be imported and the key field (Turboveg relevé numbers), ignoring the data fields already entered.

Method 2: Can be used if adding a data manually in to Turboveg.

Click on 'Modify structure' in the database menu add the new data field.

Click on the new data field created when viewing relevé data in tabular form, a window appears with options:

'Old' this should be left blank.

'New' fill in information and then click 'Replace'.

This method is useful if all relevés have the same information to be added.

If the details are different for each relevé, they can be added manually as described on p.23.

CONCLUDING REMARKS

The structure of the National Vegetation database has been described with Turboveg, the digital storage software at its core. It has been shown that within Turboveg, relevés can be stored, queried, analysed or exported to other compatible programmes.

This manual has provided information and usable resources to aid in standardising vegetation recording techniques in the field and has laid out step by step instructions in the use of Turboveg software for data storage. This guide is intended to be used alongside the official Turboveg manual available from the Turboveg website.

Although the input of present and historical relevés in to the database will be completed in 2012, when data analyses can truly begin, it is a fluid project. Therefore it is important that relevés are continually added to the database beyond 2012 to increase the knowledge base in the future. This will allow the future vegetation classification system to develop and evolve as new data is collected. To facilitate this development it is imperative that vegetation surveys undertaken follow standardised recording methodologies described in this manual. Surveyors should also refer to the Irish Wildlife Manuals and Unpublished Reports that provide guidelines for national surveys of specific habitats available from the National Parks and Wildlife Service (www.npws.ie/en/publications). This will enable the easy transfer of data in to the National Vegetation Database and allow for more effective analyses of the data.

The development of the National Vegetation Database so far, is very much due to the goodwill of surveyors who have kindly supplied their data to the National Biodiversity Data Centre for inclusion in the database. It is vitally important that surveyors continue to provide vegetation data to facilitate future monitoring and conservation of habitats on a national and European level, particularly in the light of the loss of biodiversity in recent times.

REFERENCES

Braun-Blanquet, J. and Tüxen, R. (1952) Irische Pflanzengesellschaften. *Veröff. Geob. Inst. Rübel* **25**: 224-421.

Bryant, J.A., Stewart, N.F. and Stace, C.A. (2002) A checklist of Characeae of the British Isles. *Watsonia* 24: 203–208.

Coppins, B.J. (2002) *Checklist of Lichens of Great Britain and Ireland*. London: British Lichen Society.

Fossitt, J.A. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny.

Hennekens, S.M. and Schaminee J.H.J. (2001) Turboveg, a comprehensive database management system for vegetation data. *Journal of Vegetation Science* **12:** 589-591.

Hill, M.O. (1979) *TWINSPAN – A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes*. Cornell University, Ithaca, NY, US.

Holyoak, D.T. (2003) *The distribution of bryophytes in Ireland*. Dinas Powys, Vale of Glamorgan: Broadleaf Books.

Holyoak, D.T. (2006) Progress towards a species inventory for conservation of bryophytes in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, **106B** (3), 225-236.

McCune, B. and Mefford, M.J. (2006) *PC-ORD. Multivariate Analysis of. Ecological Data. Version 5.* MjM Software, Gleneden Beach, Oregon, U.S.A.

O'Sullivan, E. and FitzPatrick, U. (2007) *National Vegetation Audit: inventory of the main sources of vegetation data in Ireland*. Unpublished report, National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Perrin P.M., Barron S.J. and Martin J.R. (2006) *National Survey of Native Woodland in Ireland: Second Phase Report*. Unpublished report, National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Perrin, P.M., Barron, S.J., Roche, J.R. and O'Hanrahan, B. (2010) Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. *Irish Wildlife Manuals*, No. **46**. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Perrin, P., Martin, J., Barron, S., O'Neill, F., McNutt, K. and Delaney, A. (2008) *National Survey of Native Woodlands - Volume 1 Main Report.* Unpublished Report to the National Parks & Wildlife Service.

Podani, J. (1994) *Multivariate Data Analysis in Ecology and Systematics. A methodological guide to the SYN-TAX 5.0 package*. SPB Publishing, The Hague, The Netherlands.

Praeger, R.L.I. (1901). Irish Topographical Botany. *Proceedings of the Royal Irish Academy* **23** (3rd. series, 7): 1-410.

Rodwell, J.S. (2006) *National Vegetation Classification: Users' Handbook*. Joint Nature Conservation Committee, Peterborough.

Rodwell, J.S. Schaminée, J.H.J., , Mucina, L., Pignatti, S., Dring, J., and Moss, D. (2002) *The diversity of European vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitats*. National Reference Centre for Agriculture, Nature and Fisheries, Wageningen, NL.

Ryle, T., Murray, A., Connolly, C., and Swann, M. (2009) *Coastal Monitoring Project 2004-2006* Unpublished Report to the National Parks & Wildlife Service.

Scannell, M.J.P and Synnott, D.M. (1987) *Census Catalogue of the Flora of Ireland*. Clar de Phlandaí na hÉireann. 2nd. edition. Stationery Office, Dublin.

Smith, G.F., Donoghue, P., O' Hora, K., and Delaney, E., (2010). *Best Practice Guidance for Habitat Survey and Mapping*. The Heritage Council, Ireland.

ter Braak, C.J.F. (1986) Canonical correspondence analysis: a new eigenvector method for multivariate direct gradient analysis. *Ecology*, **67,** *1167-1179*.

Tichy, L. (2002) JUICE, Software for Vegetation Classification. *Journal of Vegetation Science*. **13**: 451-453

White, J. and Doyle, G.J. (1982). The vegetation of Ireland: a catalogue raisonné. *Journal of Life Sciences, Royal Dublin Society* **3**: 289-368.

Wildi, O. and Orlóci, L. (1996) *Numerical Exploration of Community Patterns. A guide to the use of MULVA-5.* 2nd edition. SPB Academic Publishing b.v., Amsterdam, 171 pp.

APPENDIX I: DEFAULT TURBOVEG DATA FIELDS AND THEIR INTERPRETATION WITHIN THE NATIONAL VEGETATION DATABASE

Grey fields are mandatory data fields.

	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION	NOTES
1	Relevé number	RELEVÉ_NR	N	6	0	Relevé number (= system number)	These are sequential numbers which are allocated by the Data Centre to relevés included in the National Vegetation Database.
2	Country code	COUNTRY	C	2	0	Country code	Use IE
3	Literature reference	REFERENCE	C	6	0	Publication reference number	*Field not used; replaced with text field 48 (Data fields Table 2).
4	Nr. Table in publ	TABLE_NR	C	6	0	Number of table in publication	If data is entered from a published table, the number of that table should be entered here.
5	Nr. Relevé in table	NR_IN_TAB	C	3	0	Relevé number in table	If data is entered from a published table, the number of the relevé within that table should be entered here.
6	Cover abundance scale	COVERSCALE	C	2	0	Cover scale	Use one of the default options. If your abundance scale is not one of the default options, please contact the Data Centre.
7	Project code	PROJECT	C	3	0	Project code	A project code is allocated retrospectively to each survey by the Data Centre
8	Author code	AUTHOR	C	4	0	Author code	*Field not used; replaced with text field 46 (Data fields Table 2).
9	Date (year/month/day)	DATE	C	8	0	Date (year/month/day)	
10	Syntaxon code	SYNTAXON	C	7	0	Syntaxon code	
11	Relevé area (m^2)	SURF_AREA	N	7	2	Surface area (m^2)	
12	UTM grid system code	UTM	C	15	0	UTM grid reference	Field not used
13	Altitude (m)	ALTITUDE	C	4	0	Altitude (m)	Conversion factor used: 1ft=0.3048m
14	Aspect (degrees)	EXPOSITION	C	3	0	Aspect ('NWZO')	
15	Slope (degrees)	INCLINATIO	C	2	0	Inclination (degrees)	
16	Cover total (%)	COV_TOTAL	N	3	0	Total cover (%)	

	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION	NOTES
17	Cover tree layer (%)	COV_TREES	N	3	0	Cover trees (%)	
18	Cover shrub layer (%)	COV_SHRUBS	N	3	0	Cover shrubs (%)	
19	Cover herb layer (%)	COV_HERBS	N	3	0	Cover herb layer (%)	
20	Cover moss layer (%)	COV_MOSSES	N	3	0	Cover mosses (%)	
21	Cover lichen layer (%)	COV_LICHEN	N	3	0	Cover lichens (%)	
22	Cover algae layer (%)	COV_ALGAE	N	3	0	Cover algae (%)	
23	Cover litter layer (%)	COV_LITTER	N	3	0	Cover litter (%)	
24	Cover open water (%)	COV_WATER	N	3	0	Cover open water (%)	
25	Cover bare rock (%)	COV_ROCK	N	3	0	Cover bare rock (%)	
26	Height (highest) trees (m)	TREE_HIGH	N	2	0	Height (high) tree layer (m)	
27	Height (lowest) trees (m)	TREE_LOW	N	2	0	Height (low) tree layer (m)	
28	Height (highest) shrubs (m)	SHRUB_HIGH	N	4	1	Height (high) shrub layer (m)	
29	Height (lowest) shrubs (m)	SHRUB_LOW	N	4	1	Height (low) shrub layer (m)	
30	Aver. height (high) herbs (cm)	HERB_HIGH	N	3	0	Mean height high herb layer (cm)	
31	Aver. height lowest herbs (cm)	HERB_LOW	N	3	0	Mean height low herb layer (cm)	
32	Maximum height herbs (cm)	HERB_MAX	N	3	0	Maximum height herb layer (cm)	
33	Maximum height cryptograms (mm)	CRYPT_HIGH	N	3	0	Mean height cryptogram layer (mm)	

	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION	NOTES
34	Mosses identified (y/n)	MOSS_IDENT	C	1	0	Mosses identified (Yes/No)	Only used when it is clearly stated that **all** mosses have been identified.
35	Lichens identified (y/n)	LICH_IDENT	C	1	0	Lichens identified (Yes/No)	Only used when it is clearly stated that **all** lichens have been identified.
36	Remarks	REMARKS	C	56	0	Remarks	
37	County	COUNTY	C	2	0	Irish county codes created for Turboveg by Teagasc	Use the default codes provided.

APPENDIX II: ADDITIONAL GENERAL USE TURBOVEG DATA FIELDS CREATED AND USED WITHIN THE NATIONAL VEGETATION DATABASE

Grey fields are mandatory data fields.

	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION	NOTES
38	Location	LOCATION	C	99	0	Location	
39	Vice county (botanical)	V_COUNTY	C	3	0	Vice county (botanical)	
40	Habitat type	HAB_TYPE	C	99	0	Habitat type	Fossitt habitat categories should be used where possible.
41	Easting	X_COORD	C	6	0	Easting	An Irish grid reference, an easting and northing, or a latitude and longitude must be supplied.
42	Northing	Y_COORD	C	6	0	Northing	
43	Latitude	LATITUDE	N	6	0	Latitude	
44	Longitude	LONGITUDE	N	6	0	Longitude	
45	Irish grid reference	GRID_CODE	C	10	0	Irish grid reference	
46	Author name	AUT_NAME	C	99	0	Author name	This is the name of the person who collected the relevé information. Format used: Andy Bleasdale
47	Name of data enterer	ENT_NAME	C	99	0	Name of data enterer	This is the name of the person who entered the data into Turboveg. Format used: Ellen O'Sullivan
48	Literature source	LIT_SOURCE	C	99	0	Literature source	This refers to the survey/project within which the relevé was collected.
49	Focal plant species	PLANT_SPP	C	99	0	Focal plant species	Where a relevé is part of a survey on a specific plant (e.g., rare/threatened), the name of the focal species is entered here.
50	Sample number of relevé in original survey	SAMPLE_NO	C	20	0	Sample number of relevé in original survey	This refers to the number given to the relevé in its original survey.
51	Site number	SITE_NO	C	20	0	Site code	This refers to the site code given to the relevé in its original survey.
52	Quadrat dimensions	QUAD_DIMS	C	7	0	Quadrat dimensions	Format used: 3x1

APPENDIX III: EXCEL DATABASE OF MORE SPECIALISED TURBOVEG DATA FIELDS CREATED AND USED WITHIN THE NATIONAL VEGETATION DATABASE

This list is likely to increase as new surveys with data fields not included here are added. A continually updated version of this table is made available through the National Vegetation Database website.

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Additional Vegetation cover values						
% Cover values - general	% canopy in quadrat (woodland)	CANOPY	C	15	0	Percentage area of canopy in quadrat
	% ground shrub cover (woodland)	COV_GRSHR	C	15	0	Percentage ground shrub cover in woodland quadrat
	% field layer in quadrat	FIELD_LYR	C	15	0	Percentage area of field layer in quadrat
	% ground layer in quadrat	GROUND_LYR	C	15	0	Percentage area of ground layer in quadrat
	% cover of ground layer	COV_GLAYER	C	15	0	Give % cover for ground layer vegetation
	% Scrub cover	COV_SCRUB	C	15	0	Give the % cover of scrub in a relevé
	% cover dwarf shrubs	DSHRB_COV	C	15	0	Cover of dwarf shrubs (%)
	% cover tall herbs	THERB_COV	C	15	0	The cover of tall herbs (%)
	% cover graminoids	GRAM_COV	C	15	0	Percentage cover of graminoids
	% cover grasses	COV_GRASS	C	15	0	Gives the % grass cover in a relevé
	% cover of forbs	COV_FORBS	C	15	0	Gives % cover of forbs in a relevé
	% cover reeds	COV_REED	C	15	0	% cover of reeds in a relevé
	% cover of sedges	COV_SEDGE	C	15	0	Gives the % sedge cover in a relevé
% cover values - aquatic vegetation	% cover emerged plants in water	COV_EMER	C	15	0	% cover of emergent plants in water
	% cover floating leaf plants	COV_FLL	C	15	0	% cover of floating leaf plants in water
	% cover submerged plants	COV_SUB	C	15	0	% cover of submerged plants in water

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
% cover values - woodland vegetation	% cover of main canopy	COV_CANM	C	15	0	% cover for dominant tree species which makes up most of the canopy cover
	% cover of canopy (other trees)	COV_CANO	C	15	0	% cover for trees other than the dominant tree species that have been planted or naturally regenerated
	% cover of large shrubs	COV_SHRBL	C	15	0	% cover of large shrubs (2-5m in height) in a woodland relevé
	% cover of brambles	COV_BRAMB	C	15	0	% cover of woody vegetation with scrambling growth habit including Rosa and Rubus species
	% cover of climbers	COV_CLIMB	C	15	0	% cover of woody plants with creeping or climbing growth habit including Hedera and Lonicera
	% cover of ferns	COV_FERN	C	15	0	% cover of ferns in a relevé
% cover values - bryophytes/lichens/algae	% cover of sphagnum	COV_SPHAG	C	15	0	Gives the % cover of Sphagnum in a relevé
	% cover of bushy lichens	COV_BLICH	C	15	0	Gives the % cover of bushy lichens
	% cover of crustose lichens	COV_CLICH	C	15	0	Gives the % cover of crustose lichens
	% cover of lichens given as a range of values	COV_LICH	C	15	0	% cover of lichens given as a range of values
	% cover filamentous algae	COV_FILAL	C	15	0	Percentage cover of filamentous algae in quadrat
	% algal mat present on bare peat	ALGAL_MAT	C	15	0	Percentage of algal mat present on bare peat
% cover values - dead vegetation	% cover dead vegetation	DEAD_VEGN	C	15	0	Percentage of dead vegetation
	% cover dead wood (woodland)	DEADWOOD	C	15	0	Percentage area of dead wood present in quadrat
	% cover decayed vegetation	DECAY_VEGN	C	15	0	Percentage of decayed vegetation in quadrat
	% cover tidal litter	TIDAL_LITT	C	15	0	Percentage of tidal litter present in quadrat

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Braun-Blanquet cover values	Cover abundance (BB old) for algae	ALGACOV_BB	C	1	0	Cover abundance in Braun-Blanquet (old) scale for algae in a quadrat.
	Cover abundance (BB old) for bryophytes	BRYOCOV_BB	C	1	0	Cover abundance in Braun-Blanquet (old) scale for bryophytes in a quadrat
Domin Cover values	Bare earth Cover - DOMIN scale	DOM_EARTH	N	2	0	Bare earth cover is given a DOMIN cover value in the relevé
	Bracken Cover - DOMIN scale	DOM_BRACK	N	2	0	Bracken cover is given a DOMIN cover value in the relevé
	Dung Cover - DOMIN scale	DOM_DUNG	N	2	0	Dung cover is given a DOMIN cover value in the relevé
	Dwarf Shrub Cover - DOMIN scale	DOM_DSHRB	N	2	0	Dwarf shrub cover is given a DOMIN cover value in the relevé
	Forbs Cover - DOMIN scale	DOM_FORBS	N	2	0	Forbs cover is given a DOMIN cover value in the relevé
	Grass/Sedge Cover - DOMIN scale	DOM_GRSSG	N	2	0	Grass/sedge cover is given a DOMIN cover value in the relevé
	Litter Cover - DOMIN scale	DOM_LITTER	N	2	0	Litter cover is given a DOMIN cover value in the relevé
	Macro-lichen Cover - DOMIN scale	DOM_LICHEN	N	2	0	Macro-lichen cover is given a DOMIN cover value in the relevé
	Moss Cover - DOMIN scale	DOM_MOSS	N	2	0	Moss cover is given a DOMIN cover value in the relevé
	Rock Cover - DOMIN scale	DOM_ROCK	N	2	0	Rock cover is given a DOMIN cover value in the relevé
	Shrub Cover - DOMIN scale	DOM_SHRB	N	2	0	Shrub cover is given a DOMIN cover value in the relevé
Additional other cover values						
% Cover values - general	% dung cover	COV_DUNG	C	15	0	Gives % dung cover in a relevé
	% Shade cover	COV_SHADE	C	15	0	% shade cover
	% boulder cover	COV_BOU	C	15	0	Percentage cover of boulders (not bare) in quadrat

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Additional vegetation measurements						
Specific height - general vegetation	Height - maximum of vegetation	MAX_HT	C	15	0	Maximum height of vegetation (cm)
	Height -average/general of vegetation (cm)	AVERAGE_HT	C	15	0	Gives average or general height of vegetation in a relevé. Measured in cm
Specific height - vegetation groups	Height - forbs	FORBS_HGHT	C	15	0	Gives the height of forbs in a relevé
	Height - shrubs	SHRUB_CM	C	15	0	Height of shrubs in cm
	Height - graminoids	GRAM_HGHT	C	15	0	Height of graminoids in cm
	Height - mosses	MOSS_MM	C	15	0	Moss height (mm)
	Height - reed vegetation	REED_CM	C	15	0	Height of reed vegetation in a relevé. Measured in cm
Specific height - aquatic vegetation	Height - emergent vegetation (aquatic)	EMER_HIGH	C	15	0	Height of Emergent vegetation in cm
	Height - floating leaf vegetation (aquatic)	FLL_HIGH	C	15	0	Height of Floating leaf vegetation in cm
	Height - submergent vegetation (aquatic)	SUB_HIGH	C	15	0	Height of submergent vegetation in cm
Vegetation height range	Height - range of herb/grasses	RANGEHB_CM	C	20	0	Range of height of herb/grass (cm)
	Height - range of scrub height	SCRB_HRNG	C	20	0	Gives the range of height of scrub present in a relevé
	Height - range of shrub height	SHRB_HRNG	C	20	0	Gives the range of height of shrubs present in a relevé
	Height -range of tree height	TREE_HRNG	C	20	0	Gives the range of height of trees present in a relevé

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Additional area, altitude, aspect measurements						
General surveys	Altitude range	ALT_RANGE	C	15	0	Altitude given as a range measured in metres.
	Aspect NSEW	ASP_NSEW	C	15	0	Aspect is given in relation to the compass rose, north, south, east, west e.g. NNW, ENE, S W etc
	Aspect of quadrat NSEW	ASP_QUAD	C	15	0	Aspect of quadrat is given in relation to the compass rose, north, south, east, west e.g. NNW, ENE, S W etc
	Slope range	SLOPE_RNGE	C	15	0	Gives slope range value in degrees
	Relevé exposed or sheltered	EXP_DES	C	99	0	Whether the position of the relevé was exposed or sheltered.
	Measurement of area within which a survey took place	AREA_DIM	C	15	0	The measurement of the dimensions of an area being surveyed within which relevés were taken (m).
Aquatic surveys	Lake area	AREA_LAKE	C	15	0	Lake area measured in Hectares
	River bank height	BANK_HIGH	C	15	0	Height of bank (cm)
	River channel width	CHAN_WIDTH	C	15	0	Width of river channel (m)
	Length of river stretch surveyed	STR_LENGTH	C	15	0	The length of the stretch of river surveyed.
Landscape & topography						
General descriptions	Description of habitat within relevé	HAB_DESC	C	99	0	Description of vegetation habitat within the relevé
	Description of surrounding landscape	LANDSCAPE	C	99	0	The surrounding landscape
	Description of microtopography	MICRO_TOP	C	99	0	The micro-topography of the relevé
	Description of relevé surface	SURFACE	C	99	0	Description of the surface of the relevé
Phenology	Phenology measurement	PHENOLOGY	C	99	0	Phenology of the stand

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Landuse and management						
Human impact	Surrounding landuse	LANDUSE	C	99	0	The surrounding landuse
	Level of site disturbance	DISTURB	C	99	0	Level of site disturbance
	Habitat conditions	HAB_COND	C	99	0	Habitat conditions
	Description of threats - general	THREATS	C	99	0	A short description of any potential threats to the vegetation within the survey area such as grazing
	Damage	DAMAGE_CAT	C	99	0	Damage category
	Relevé in area that is burnt or not	BURNING	C	99	0	If area is burnt
	Relevé in coppiced area or not	COPPICE	C	99	0	Quadrat taken in coppiced area or not
	Recreational use	REC_USE	C	99	0	Extent or description of recreational use
	Trampling	TRAMPLING	C	99	0	Extent or description of trampling in a relevé
	Drainage	DRAINAGE	C	99	0	Extent or description of drainage in an area, can be natural or man-made
Vegetation impact	Scrub Threat	SCR_THRT	C	99	0	This value represents the threat of scrub invasion in to existing vegetation
	Bracken Threat	BRACK_THRT	C	99	0	This value represents the threat of bracken invasion in to existing vegetation
	Calluna Threat	CALL_THRT	C	99	0	This value represents the threat of Calluna invasion in to existing vegetation
	Hazel Threat	HAZ_THRT	C	99	0	This value represents the threat of Hazel invasion in to existing vegetation
	Scrub Threat, excluding hazel	OSCB_THRT	C	99	0	This value represents the threat of scrub invasion, other than hazel in to existing vegetation

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Animal impact	Level of site grazing	GRAZING	C	99	0	Levels of grazing
	Summer Grazing Intensity	SUM_GRAZE	C	99	0	This value represents the intensity of summer grazing in the sample area
	Winter Grazing intensity	WIN_GRAZE	C	99	0	This value represents the intensity of winter grazing in the sample area
	Poaching	POACHING	C	99	0	Percentage Area poached
Soil & substrate						
Substrate description	Soil type	SOIL_TYPE	C	99	0	Soil type
	Substrate description	SUBSTRATE	C	99	0	Description of substrate. Example whether firm or soft underfoot, or general description of particle size
	Description of geological bedrock	GEO_TYPE	C	99	0	Describes the surrounding geological bedrock
	Parent material of soil	PRNT_MTRL	C	99	0	Parent material of soil
Substrate depth	Depth - peat	PEAT_DEPTH	C	15	0	Depth of peat in cm or m
	Soil depth	SOIL_CM	N	5	1	Soil depth (cm)
	Soil depth range	SOIL_RANGE	C	15	0	Soil depth is given a range of depth measurements
	Range of depth of substrate	SUB_RGECM	C	20	0	Gives the range of depth of soil/peat etc in a relevé. Measured in cm

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Substrate analyses	Soil moisture content or range	MOIST_CONT	C	15	0	Gives the moisture content or range in a soil sample
	Soil moisture %	MOIST_SOIL	C	15	0	Percentage Soil moisture
	Soil organic matter content	ORG_CONT	C	15	0	Gives the amount of organic matter in a soil sample
	pH measurement	PH_VAL	N	3	1	pH
	Calcium content	SOIL_CA	N	10	3	Gives the calcium content in a soil sample
	Phosphorus content	SOIL_P	N	10	3	Gives the phosphorus content in a soil sample
	Potassium content	SOIL_K	N	10	3	Gives the potassium content in a soil sample
	Magnesium content	SOIL_MG	N	10	3	Gives the magnesium content in a soil sample
	Carbon content	SOIL_CARB	N	10	3	Carbon content in a soil sample
	Nitrogen content	SOIL_NIT	N	10	3	Nitrogen content in a soil sample
	Loss on ignition	LOI_SOIL	N	10	3	Loss on ignition of a soil sample
Bare substrate cover values	% bare substrate cover	BAR_SUB	C	15	0	Percentage cover of bare substrate in quadrat
	% bare mud cover	BARE_MUD	C	15	0	Percentage of bare mud in quadrat
	% bare peat cover	BARE_PEAT	C	15	0	Percentage of Bare Peat
	% bare soil cover	BARE_SOIL	C	15	0	Cover bare soil (%)
	% bare gravel cover	BAR_GRAV	C	15	0	Percentage cover of bare gravel in a quadrat
	Braun Blanquet bare ground cover	BB_GROUND	C	1	0	Bare ground cover in a quadrat using the Braun-Blanquet (old) scale

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Substrate cover values in river beds	% clay cover in river bed	COV_CLAY	C	15	0	% cover of clay in the river bed substrate
	% silt cover in river bed	COV_SILT	C	15	0	% cover of silt in the river bed substrate
	% sand cover in river bed	COV_SAND	C	15	0	% cover of sand in the river bed substrate
	% gravel cover in river bed	COV_GRAVEL	C	15	0	% cover of gravel in the river bed substrate
	% stone cover in river bed	COV_STONES	C	15	0	% cover of stones in the river bed substrate
	% boulder cover in river bed	COV_BOUL	C	15	0	% cover of boulders in the river bed substrate
	% rock cover in river bed	COV_RCK	C	15	0	% cover of rock in the river bed substrate
	% bedrock cover in river bed	COV_BDR	C	15	0	% cover of bedrock in the river bed substrate
	% marl cover in river bed	COV_MARL	C	15	0	% cover of marl in the river bed substrate
	% peat cover in river bed	COV_PEAT	C	15	0	% cover of peat in river bed substrate
Water						
General	Water depth	WATER_CM	C	15	0	Water depth (cm)
	Depth of water table	WAT_TABLE	C	15	0	Depth of the water table measured from the surface of the ground down to the surface of the water table underground (m)
	Waterbody size	WATBD_SZE	C	99	0	Size of water body was based on the width of water channel.
	Frequency of flooding	FLOODING	C	99	0	Frequency of flooding
	Flow rate	FLOW_RATE	C	99	0	How fast the water was flowing in the brook, stream or river
Water analyses	Alkalinity of water sample	ALK_MEAS	N	5	2	Alkalinity of water samples was measured in 'ml HCL'
	Calcium hardness of water sample	CA_MEAS	N	5	1	Measurement of Ca hardness in river water samples
	Water salinity	SALINITY	N	5	3	Salinity of water
	Total Phosphate in water sample	TOTAL_P	N	5	3	Total phosphate in a river water sample
	Conductivity of water sample	COND_MEAS	N	5	1	Conductivity of water samples was measured in 'µS'

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Permanent plots and transects						
General	Year quadrat was resurveyed	YEAR_QUAD	C	15	0	Year quadrat was re-surveyed
	Whether quadrat is staked or not	STAKED	C	15	0	Whether quadrat is staked or not
	Exclosure size	EXCL_SIZE	C	15	0	Exclosure size (m2)
	Exclosure code	EXCL_CODE	C	15	0	Exclosure code used in report
	Length of transect	LENGTH_TRAN	C	15	0	Length of transect
	Origin of transect	ORIGIN_TR	C	99	0	Description of habitat at the origin of transect
	Position of quadrat along transect	POS_QUAD	C	15	0	Position of quadrat along transect
	Quadrat frequency	QUAD_FREQ	C	15	0	Quadrat frequency
	Endpoint of transect	END_TR	C	99	0	Description of habitat at the endpoint of transect
	Transect code	TRAN_NAME	C	15	0	Gives the name or code of a transect
	Transect number within survey	TRANSECT	C	15	0	Transect number in survey
General survey codes						
General	Site code in original survey	SITE_NO	C	20	0	Site code in original survey
	Plant community that the relevé has been assigned to	COMMUNITY	C	99	0	Plant communities
	Quadrat position	QUAD_POS	C	99	0	Describes where a relevé is positioned in relation to surrounding features such as lake shore or exclosure

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Codes used in specific surveys						
Survey specific codes		CALL_DETAILS	C	99	0	Details about Calluna vulgaris, growth phase and height and condition of heather
		COPP_ENDX	C	15	0	X coordinate for end of the coppiced area
		COPP_ENDY	C	15	0	Y coordinate for end of coppiced area
		COPPICE_YR	C	15	0	Year wood was coppiced
		COV_GRSSP	C	15	0	Gives % cover of some grass species in a relevé
		RHODO_CAT	C	99	0	Assigns a category based on branching and height to Rhododendron plants recorded in a relevé
		RUP_DITCH	C	15	0	Percentage 'Ruppia' ditch bank present in quadrat
		SUBCOMP	C	15	0	Sub-compartment of wood
		WOOD_ENDX	C	15	0	X coordinate for end of the wooded area
		WOOD_ENDY	C	15	0	Y coordinate for end of the wooded area
		ZONE	C	99	0	Zone in woodland
		PLOT_NUMB	C	15	0	Plot number in Brackloon Wood
		SAMPLE_PT	C	15	0	Sample point in relation to the lagoon
		TOPOGRAPHY	C	15	0	Unique codes for topography/Habitat
		DUNG_TYPE	C	15	0	Describes the type of dung found within a relevé
		NPHYTOCODE	C	15	0	NPHYTO code
		COWPAT_NO	C	15	0	Gives the number of cowpats present in a relevé
		HYDRO_PER	C	15	0	Gives the hydroperiod of an area in which a relevé was taken

TYPE	FIELD NAME	FIELD_CODE	TYPE	LENGTH	DECIMAL	DESCRIPTION
Woodland survey codes	Forest type	FOR_TYPE	C	99	0	Describes the woodland/ forest type in terms of the dominant trees species present
	Forest structure	FOR_STRUC	C	99	0	Describes the woodland/ forest structure. Example: Pre-thicket, thicket, mature, re-opening
	Forest age	FOR_AGE	C	15	0	Gives the age in years of the woodland/ forest at the time when surveyed
	Tree distance	DIST_TREES	C	15	0	Distance between planted trees in a woodland/forest
	Year of tree planting	YEAR_PLANT	C	15	0	The year that the trees were planted in a woodland/forest
	Litter depth	LITT_DEPTH	C	15	0	Depth of litter in a woodland/forest measured in cm

APPENDIX IV: FULL LIST OF ALL DATASETS THAT HAVE BEEN DIGITISED TO TURBOVEG AND THAT ARE INCLUDED IN THE NATIONAL VEGETATION DATABASE (SEPTEMBER 2010).

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
McGough, H.N. (1984). A Report on the Grasslands and Closely Related Vegetation of the Burren Region. Unpublished NPWS Report	81	NPWS 001	NPWS	NPWS	Data Centre
Curtis, T.G.F. & McGough, H.N. (1981). A Survey of the Wetlands of the Fergus Catchment and Adjoining areas. Unpublished NPWS Report	45	NPWS 002	NPWS	NPWS	Data Centre
Irish Rare Flora Survey-Protected Flora. Unpublished NPWS survey	110	NPWS 003	NPWS	NPWS	Data Centre
Irish Rare Flora Survey-Threatened Flora. Unpublished NPWS survey	38	NPWS 004	NPWS	NPWS	Data Centre
Irish Rare Flora Survey-Scarce Species. Unpublished NPWS survey	58	NPWS 005	NPWS	NPWS	Data Centre
Crawford, I., Bleasdale, A. and Conaghan J. (1998) Biomar survey of Irish machair sites, 1996. Volume 2: Plant communities. *Irish Wildlife Manual* No 04	1450	NPWS 006	NPWS	NPWS	Data Centre
O'Criodain, C. (1988). *Parvocaricetea* in Ireland. Ph.D. Thesis. University College Dublin.	284	NPWS 007	O'Criodain, C.	UCD	Data Centre
Bleasdale, A. (1998). NPWS. Unpublished relevés	50	NPWS 008	NPWS	NPWS	Data Centre
Brock, T., Frigge, P. and Ster, van der H. (1978). A vegetation study of the pools and surrounding wetlands in the Dooaghtry area, Co. Mayo. Unpublished NPWS	366	NPWS 009	Report	NPWS	Data Centre
Beckers, A., Brock, T. and Klerkx, J. (1976). A vegetation study of some parts of Dooaghtry, Co. Mayo, Republic of Ireland. Laboratory for Geobotany, Catholic University Nijmegen. Unpublished NPWS Report	339	NPWS 010	NPWS	NPWS	Data Centre
Lockhart, N. D. (1984). A report on the wetland vegetation of the Dunkellin and Lavelly River catchments, Forest & Wildlife Service, Dublin. Unpublished NPWS report.	107	NPWS 011	NPWS	NPWS	Data Centre
Saltmarshes of Coastal Vegetation Survey (1972). Unpublished. University College Dublin.	377	UCD 002	UCD	UCD	Data Centre
Ní Annrachaín, O. (1972). North Bull Island vegetation data. University College Dublin.	206	UCD 003	Ní Annrachaín. O	UCD	Data Centre
Sand dune survey (1966-1983). Unpublished. University College Dublin.	20	UCD 004	UCD	UCD	Data Centre
Saltmarsh student survey (1970s), validated by J.J.Moore. University College	25	UCD 005	UCD	UCD	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
Dublin.					
Caffrey, J. (1990). The Classification, Ecology and Dynamics of Aquatic Plant Communities in some Irish Rivers. PhD thesis. University College Dublin.	235	UCD 006	Caffrey, J.	UCD	Data Centre
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren, Co. Clare. Proceedings of the Royal Irish Academy. Vol. 64, sect. B. pp211-299.	429	IND 001	Ivimey Cook, R.B. & Proctor, M.C.F.	Published source	Data Centre
Mac Gowran F. L. (2000). The influence of anthropogenic activity on the vegetation of Atlantic blanket bog in the west of Ireland. Ph.D. thesis. University College Dublin.	428	UCD 007	MacGowran, F.	UCD	Data Centre
Wetland Survey (fens) Forest & wildlife Service. 1975-1980. Unpublished NPWS report.	53	NPWS 012	NPWS	NPWS	Data Centre
Wetland Survey of Lough Carra (BSBI) Forest & wildlife Service. 1974. Unpublished NPWS report.	70	NPWS 013	NPWS	NPWS	Data Centre
Wetland Survey. Forest & Wildlife Service. 1974-1978. Unpublished NPWS report.	120	NPWS 014	NPWS	NPWS	Data Centre
O'Connell, M. (1977). The phytosociology and ecology of Scragh Bog, Co.Westmeath. PhD thesis. University College Dublin.	195	UCD 008	O'Connell, M.	UCD	Data Centre
Regan, E. (2005). An investigation of the plant, carabid and staphylinid communities of turloughs in South East Galway/North Clare, Ireland. PhD Thesis. National University of Ireland, Galway	90	NUIG 001	Regan, E.	NUIG	Data Centre
Tobin G. (2005). Botanical Survey of Garriskill (Grassland & Woodland), Co. Westmeath Ardgullion Bog, Co. Longford Bellanagare Bog, Co Roscommon and Kilbarry Bog, Co. Roscommon. For National Parks and Wildlife Service – Northern Division Surveys 2005.	458	NPWS 015	NPWS	NPWS	Data Centre
Farrell, C. (2001). An ecological study of intact and industrial cutaway Atlantic blanket bog at Bellacorick, North west Mayo. PhD Thesis, University College Dublin.	425	UCD 009	Farrell, C.	UCD	Data Centre
Dwyer, R. & Wann, J. (2005) Survey Reports produced for National Parks & Wildlife, Moyne Division for Glen Lough, Fisherstown Bog, Killyconny Bog and Ballinderry & Ballynagrenia Bogs.	66	NPWS 016	NPWS	NPWS	Data Centre
Farrell, C. (2004) Mayo National Park Exclosure Study. Unpublished NPWS report.	102	NPWS 017	NPWS	NPWS	Data Centre
Foss, P. (1986).The distribution, phytosociology, autecology and post glacial history of *Erica erigena* R.Ross in Ireland. PhD Thesis, University College Dublin.	66	UCD 010	Foss, P.	UCD	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
Smith, G. (2007). NPWS- North Midlands Region- North Midlands Botanical Surveys Annagh Lough Wood & St. John's Wood, 2007. Unpublished NPWS report.	60	NPWS 018	NPWS	NPWS	Data Centre
Fox, H., M. Cullen, D.J. Little, D. Ryan, P. Ciaurriz, R. Dwyer & G.M. Boyle (2001). Vegetation monitoring and botanical survey of Brackloon Wood, Westport, Co. Mayo. Forest Ecosystem Research Group, Report number 31. Department of Environmental Resource Management, University College Dublin. 91pp.	126	UCD 011	UCD/NPWS	UCD/NPWS	Data Centre
NATURA Environmental Consultants (2006). Botanical Surveys 2006 North Midlands cSACs. Unpublished NPWS report.	53	NPWS 019	NPWS	NPWS	Data Centre
Conaghan, J. (1998). A study of the vegetation and ecohydology of Sharavogue Bog, Co. Offaly, with particular reference to the lagg zone. Unpublished NPWS report.	141	NPWS 020	NPWS	NPWS	Data Centre
Conaghan, J. (1998). A study of the vegetation and ecohydology of Clonfinane Bog, co. Tipperary. Unpublished NPWS report.	62	NPWS 021	NPWS	NPWS	Data Centre
Murray, A. (2003). A study of the flora of Malahide Saltmarsh during the Construction of the Northern Motorway. Fingal County Council.	51	IND 002	Fingal Co. Co./ Murray, A.	Murray, A.	Data Centre
Loftus, M. & Scott, L. (1996). A monitoring programme, towards the development of nature conservation management policy, in Laragh West, County Wicklow. Unpublished NPWS report.	15	NPWS 022	NPWS	NPWS	Data Centre
Hatch, P. (1996). A survey of the vegetation of Irish Coastal Lagoons. Unpublished NPWS report.	283	NPWS 023	NPWS	NPWS	Data Centre
Gaynor, K. (2007) Flora and Vegetation of Irish Sand dune systems. PhD Thesis. University College Dublin	530	UCD 012	Gaynor, K.	UCD	Data Centre
Weekes, L. (1989) A Vegetation Survey of Glenveagh National Park and the An Taisce Property, Co. Donegal. Unpublished report for the National Parks and Wildlife Service	132	NPWS 024	NPWS	NPWS	Data Centre
Heuff, H, (1984) Vegetation of Irish Lakes Part II. Unpublished report for the National Parks and Wildlife Service	152	NPWS 025	NPWS	NPWS	Data Centre
Neefjes, M. (1989) The Vegetation of Clara Bog in relation to the Hydrology and Waterchemistry. Unpublished report for the National Parks and Wildlife Service	58	NPWS 026	NPWS	NPWS	Data Centre
Bleasdale, A., Conaghan, J. (1996) Monitoring Techniques in Quantifying	7	NPWS 027	NPWS	NPWS	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
Vegetation Change in Grazing Trials in Glenveagh National Park. Unpublished report for the National Parks and Wildlife Service.					
Patton, L. Boyle, G., O'Connell, T. (1989) An Ecological Survey of Pollardstown Fen. Unpublished National Parks and Wildlife report.	43	NPWS 028	NPWS	NPWS	Data Centre
Bleasdale, A., Conaghan, J. (1996) A Study of Woodland Exclosures in Glenveagh National Park, Co. Donegal. Unpublished report for the National Parks and Wildlife Service	46	NPWS 029	NPWS	NPWS	Data Centre
Kirby, N. And O'Connell, M. (1982). Shannawoneen Wood, Co. Galway, Ireland: The Woodland and Saxicolous Communties and the Epiphytic Flora. *Journal of Life Sciences, Royal Dublin Society*. Vol. 4, 1982, 73-96	13	INDEP 003	Kirby, N., O'Connell, M.	Published source	Data Centre
Horsfield, D. Hobbes, A., Averis, B., Kinnes, L. (1991) The Vegetation of Connemara in Relation to Plant Communities of Great Britain. Joint Nature Conservation Commitee, UK.	63	INDEP 004	Horsfield, D.	JNCC	Data Centre
Lockhart, N. (1991) Phytosociological and Ecological Studies of Lowland Blanket Bog flushes in West Galway and North Mayo. Unpublished Ph.D Thesis NUIG.	168	NUIG 002	Lockhart, N.	Lockhart, N.	Data Centre
Bleasdale, A. (1998). The Assessment of the Scientific Interest of the Dune System at White Strand, Doonbeg, Co. Clare. Report for The Heritage Council	36	INDEP 005	Bleasdale, A	Bleasdale, A.	Data Centre
Bleasdale, A., Conaghan, J. (1998). A Baseline Vegetation Survey of Derrynane National Historic Park. Unpublished report for the National Parks and Wildlife Service	34	NPWS 031	NPWS	Bleasdale, A.	Data Centre
Heuff, H. (1987). The Vegetation of Irish Rivers. Unpublished report for the National Parks and Wildlife Service	183	NPWS 030	NPWS	NPWS	Data Centre
Parr, S O'Donovan, G., Ward S., Finn, J. A. (2009) Vegetation Analyses of Upland Burren Grasslands of Conservation Interest. *Biology and Environment: Proceedings of the Royal Irish Academy*. Vol. 109B.No.1, 11-33 (2009)	400	INDEP 006	Parr, S.	Parr, S.	Data centre
Bleasdale, A., (1995). The Vegetation and Ecology of the Connemara Uplands, with Particular Reference to Sheep Grazing. Upublished Ph.D. Degree Thesis. NUIG	646	NUIG 004	Bleasdale, A.	NUIG	Data Centre
Moran, James. (2007). Unpublished releves from The Burren Co. Clare of Winterages as part of the BurrenLIFE Project	50	INDEP 007	Moran, J.	Moran, J.	Data Centre
Bleasdale, A., Wolfe-Murphy, S.A. (1998).	21	INDEP	Bleasdale, A.	Bleasdale, A.	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
Moboy Bog, Co. Tyrone. Environmental Impact Statement: Flora and Fauna. Unpublished report for Allathan Associates, Hallhill, Turriff, Aberdeenshire AB53 4BL.		008			
Mooney, E. (1991). A Phytosociological and Palaeoecological Study of the Wetlands of the Lower Corrib Basin, Co.Galway, Ireland. Unpublished Ph.D. Thesis. National University of Ireland, Galway.	258	NUIG 005	Mooney, E.	NUIG	Data Centre
Bleasdale, A., Conaghan, J. (1999). The Vegetation and Management of Barleycove Dunes, Co. Cork. Unpublished report for Cork County Council.	31	INDEP 009	Bleasdale, A.	Bleasdale, A.	Data Centre
Bleasdale, A., (1994). The Arable Weed Flora of the Rye Crop on the Aran Islands, Co. Galway. Unpublished report for the National Parks and Wildlife Service.	122	NPWS 032	Bleasdale, A.	NPWS	Data Centre
O'Sullivan, A. (1962-1982). Grassland vegetation data. Digitisation funded under a NPWS contract.	2867	External 001	O' Sullivan, A.	A. O'Sullivan, A.	Teagasc/ UCD
Data collected by V. Westhoff in Ireland. Digitisation funded under a NPWS contract.	995	External 002	Westhoff, V.	Westhoff, V.	Alterra, Wageningen, Netherlands
Perrin, P., Martin, J., Barron, S., McNutt, K. & Delaney, A. (2008) National Survey of Native Woodlands. Unpublished Report to the National Parks & Wildlife Service. Collection and digitisation funded under a NPWS contract.	1667	External 003	NPWS	NPWS	BEC Environmental Consultants
Giesen, T., Meijer, Y., & Gerts, M. (2008). Digitisation of historical Irish vegetation data collected by visiting Dutch researchers. Digitisation funded under a NPWS contract.	1015	External 004	Various authors	Various authors	Alterra, Wageningen, The Netherlands
Crushell, Patrick (2008). Soak Systems of an Irish Raised Bog: A Multidisciplinary Study of their Origin, Ecology, Conservation and Restoration. Ph.D Thesis. Wageningen University, The Netherlands	172	INDEP 010	Crushell, P.	Crushell, P.	Data Centre
Foss, P. & Crushell, P. (2007). Monaghan Fen Survey. Report and accompanying GIS datasets prepared for Monaghan County Council, National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.	54	INDEP 011	Crushell, P.	Crushell, P.	Data Centre
Foss, P. & Crushell, P. (2008). Monaghan Fen Survey II. Report and accompanying GIS datasets prepared for Monaghan County Council, National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.	16	INDEP 012	Crushell, P.	Crushell, P.	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
Crushell, P., O'Callaghan, R. J. (2008). A Survey of Red Grouse (*Lagopus lagopus*) Habitat in Ireland 2007 – 2008: An Assessment of Habitat Condition and Land-use Impacts. Unpublished Report for BirdWatch Ireland & The National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland	400	INDEP 013	Crushell, P.	Crushell, P.	Data Centre
Martin, J. (2000) A Species Based Approach to the Conservation of Irish Threatened Vascular Plant Species using Complimentary In Situ and Ex Situ Methods. Unpublished Ph.D Thesis Trinity College Dublin	49	TCD 001	Martin, J.	Martin, J.	Data Centre
Moran, J. (2005). Skealoghan Turlough, Co. Mayo: Implications of Grazing and Flooding Regimes for Plant and Carabid Beetle Communities with Reference to Turlough Farming Systems in the Region. Ph.D. Thesis. National University of Ireland, Galway.	189	NUIG 006	Moran, J.	Moran, J.	Data Centre
Telford, M. (1977). Glenveagh National Park: The Past and Present Vegetation. Unpublished Ph.D. Thesis. Trinity College Dublin.	203	TCD 002	Telford, M.	Telford, M.	Data Centre
Regan, E. (2000). An Assessment of Short Duration Trampling on Blanket Bog Vegetation in Connemara National Park and an Appraisal of Visitor Attitudes to Trampling in Connemara. Unpublished B.Sc. Thesis. National University of Ireland. Galway.	36	NUIG 007	Regan, E.	Regan, E.	Data Centre
McKee, A. M. (2000). A Phytosociological Study and detailed Vegetation Map of the Heathlands of the Western Twelve Ben Mountains Connemara, Ireland. Unpublished Ph.D. Thesis. University College Dublin.	270	UCD 013	McKee, A.M.	BEC	Data Centre
Sullivan, C. (2005). The Distribution and Impact of *Rhododendron ponticum* in Connemara National Park. Unpublished B.Sc.Thesis. National University of Ireland. Galway.	42	NUIG 008	Sullivan, C.	Sullivan, C.	Data Centre
Bleasdale, A., Conaghan, J. (1998). Survey of Turloughmore, Inis Mor, Co. Galway	16	INDEP 014	Bleasdale, A., Conaghan, J.	Bleasdale, A.	Data Centre
Bleasdale, A., Conaghan, J. (1996). A Botanical Assessment of Lurgabrack Dunes, Dunfanaghy, Co. Donegal. Unpublished report for the National Parks and Wildlife Service, Dublin.	26	NPWS 033	Bleasdale, A., Conaghan, J.	Bleasdale, A.	Data Centre
Mac Gowran, B. (1985) Phytosociological and Ecological Studies on Turloughs in the West of Ireland. Unpublished PhD thesis for National University of Ireland Galway.	227	NUIG 009	MacGowran, B.	MacGowran, B.	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
Conaghan, J. (1995) Ecological Studies of Two Rare Bog Cottons, *Eriophorum gracile*. Koch ex Roth and *E. latifolium*. Hoppe. 232pp. Unpublished PhD. NUI Galway, Ireland.	118	NUIG 003	Conaghan, J.	Conaghan, J.	Data Centre
Fojt, W. (1988). Mires Research Group Field Excursion 1988, Ireland. Independent survey for the Nature Conservancy Council, UK.	40	INDEP 015	Fojt, W.	NPWS	Data Centre
Kirby, N. E. (1981). An Ecological and Phytosociological Study of Corylus Avellana L. in the Burren, Western Ireland. Unpublished Ph.D. thesis. National University of Ireland, Galway.	227	NUIG 010	Kirby, N.	Kirby, N.	Data Centre
Dunford, B. (2001). The Impact of Agricultural Practices on the Natural Heritage of the Burren Uplands, Co. Clare. Published Ph.D. Thesis, University College Dublin	1116	UCD 014	Dunford, B.	Dunford, B.	Data Centre
O'Connor, M. J. (1992). The Ecology and Land Use of the Salt Marshes of Tawin Island, Galway Bay. Unpublished B.Sc. Thesis for the National University of Ireland, Galway.	54	NUIG 011	O'Connor, M.	Sheehy-Skeffington, M.	Data Centre
Constable, T., Cassells, D. (2002). Vegetation Studies in Ballyteige, County Clare. Unpublished report for the National Parks and Wildlife Service, Dublin.	25	NPWS 034	NPWS	NPWS	Data Centre
Carty, Helen. (2006). Assessment of the Impact of Path Construction on the Vegetation of Diamond Hill in Connemara National Park. Unpublished B.Sc. Thesis, National University of Ireland, Galway	218	NUIG 012	Carty, H.	Sheehy-Skeffington, M.	Data Centre
Deegan, B. (2002). Ecology of triangular clubrush (*Schoenoplectus triqueter*) in the Shannon estuary. Unpublished MSc. Thesis. University of Limerick	23	UL 001	Deegan, B.	Deegan, B.	Data Centre
Bleasdale, A. (1995). A Vegetation Description of Selected Sites at the Teagasc Hill Farm, Erriff River. Unpublished Independent survey for Teagasc, Co. Galway.	21	INDEP 016	Bleasdale, A.	Bleasdale, A.	Data Centre
Bleasdale, A., Conaghan, J.(1997). An Assessment of the Scientific Interest of Woodland and Associated Habitats at Rindoon, Co. Roscommon. Independent survey for the Heritage Council.	13	INDEP 017	Bleasdale, A. and Conaghan, J.	Bleasdale, A. and Conaghan, J.	Data Centre
Conaghan, J. (1999). The Vegetation, Ecology and Conservation of the Lough Oughter Lake System, Co. Cavan. Unpublished report by Enviroscope Environmental Consultancy, Galway	203	INDEP 018	Conaghan, J.	Conaghan, J.	Data Centre
Keane, S. (1990). Vegetation and Land Use Studies in the Eastern Area of the Burren, Co. Clare. Unpublished MSc. Thesis for the	100	NUIG 013	Keane, S.	Keane, S.	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
National University of Ireland, Galway					
Conaghan, J. (2000). An Assessment of the Conservation Value of Blanket Bog Landscape to the West of Galway City. Unpublished report by Enviroscope Environmental Consultancy, Galway.	207	INDEP 019	Conaghan, J.	Conaghan, J.	Data Centre
Scully, A. C. (1989). Ecological Studies of the Aquatic Species, *Eriocaulon aquaticum* (Hill) Druce and *Lobelia dortmanna* L. Unpublished MSc thesis for the National University of Ireland, Galway.	64	NUIG 014	Scully, A.	Sheehy-Skeffington, M.	Data Centre
French,L. (2005). Ground Flora Communities in Ireland's Plantation Forests: Their Diversity, Structure and Composition. Published Ph.D. Thesis.	212	TCD 003	French, L.	French, L.	Data Centre
Wolfe-Murphy, S. A., Murphy, C. (2002). Ecological Survey of the Slieve Beagh/Eshbrack Bog area, County Monaghan. Upublished report for The Truagh Development Association	153	INDEP 020	Wolfe-Murphy, S.	Wolfe-Murphy, S.	Data Centre
Dunne, F. (2000). Blanket Bog, Heath and Upland Grassland Exclosures, Baseline Surveys and Monitoring Methodologies. National Parks & Wildlife Service. Unpublished Report to Dúchas-The Heritage Service, Dublin.	54	NPWS 035	Dunne, F.	Dunne, F.	Data Centre
O' Connor, M. (2000). A Study of the Phytosociology, Vegetation Distribution & Ecology of the Roundstone Bog Complex, Connemara, Co. Galway. Unpublished PhD thesis for National University of Ireland Galway.	374	NUIG 015	O'Connor, M.	O'Connor, M.	Data Centre
Lynn, D. (2000-2005) Unpublished Turlough Releves Collected for a post-doctorate position, funded by EPA	12	INDEP 021	Lynn, D.	Lynn, D.	Data Centre
An Independant BSBI survey of Lough Carra carried out in June 1974.	101	INDEP 022	Ryan, J.	Ryan, J.	Data Centre
O'Donovan, G. (2006). A Survey of Lowland Grasslands of Conservation Interest in Sligo. Unpublished report for the Heritage Council.	176	INDEP 023	O'Donovan, G.	O'Donovan, G.	Data Centre
Lockhart, N. D. (1992). A Report on the Wetland Vegetation of the Mulkear River Catchment, Counties Limerick and Tipperary. Unpub. NPWS	113	NPWS 036	Lockhart, N.	Lockhart, N.	Data Centre
O'Connor, Á. (1996). Investigations of Small Scale Patterns and Vegetation of the Roundstone Lowland Blanket Bog Complex, County Galway. Unpublished B.Sc.Thesis. National University College, Galway.	160	NUIG 016	O Connor, Á.	O Connor, Á.	Data Centre
Hanrahan, J. (1997). The Effects of Grazing on Vegetation, Regeneration and Soils of	64	UCD 015	Hanrahan, J.	UCD	Data Centre

Source	Total number of relevés	Project code	Data owner	Verification	Digitisation completed by:
an Oak Woodland in Glendalough, County Wicklow. Unpublished MSc. thesis for University College Dublin.					
Ní Bhriain, B., Sheehy Skeffington, M., Gormally, M. (2002). Conservation Implications of Land Use Practices on the Plant and Carabid Beetle communities of two Turloughs in Co. Galway, Ireland. Published in Biological Conservation Vol. 105, 81-92	40	NUIG 017	Sheehy-Skeffington, M.	Sheehy-Skeffington, M.	Data Centre
Kirkpatrick, A.H. (1988). A Vegetation Survey of Heath and Moorland in Northern Ireland and Donegal. Unpublished Ph.D. Thesis. New University of Ulster.	298	UL 002	Kirkpatrick, A.	Perrin, P.	Data Centre
Irvine, K. M., (2004). The Comparative Ecology of *Puccinellia fasciculata, P. distans* and *P. maritima*. Unpublished M.Sc. Thesis for University College Dublin.	50	UCD 016	Irvine, K. M.	UCD	Data Centre