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THE MONITORING AND ASSESSMENT OF *HAMATOCAULIS VERNICOSUS* (SLENDER GREEN FEATHER-MOSS) IN THE REPUBLIC OF IRELAND 2015–2017

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An Roinn Cultúir, Oidhreachta agus Gaeltachta
Department of Culture, Heritage and the Gaeltacht

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Main photograph:

Slender Green feather-moss *Hamatocaulis vernicosus*, Christina Campbell

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Executive Summary

This report presents details of a 2015-2017 monitoring survey to assess the conservation status of the EU Annex II species *Hamatocaulis vernicosus*, commonly known as Slender Green Feather-moss, which is found in mesotrophic fens and flushes in Ireland.

Assessments of Population, Habitat for the Species and Future prospects, were undertaken at all 11 known sites following an established monitoring protocol.

Population was assessed at each site using three attributes: extent of occurrence, mean percent cover of *H. vernicosus* and density of shoots. Habitat for the Species at each site was assessed taking both the area and quality of suitable habitat into account. At each monitoring stop, Habitat for the Species quality assessment data were collected on hydrology, percent tree cover, percent shrub cover, percent grass cover, percent bryophyte cover, cover of *Calliergonella cuspidata* and mean vegetation height (cm). Pressures, threats and activities, both positive and negative, occurring throughout each site were also examined and used to determine the Future prospects of the site with regard to its Population and Habitat for the Species. Each site received an assessment of Favourable (green), Unfavourable-Inadequate (amber) or Unfavourable-Bad (red) for each of the three parameters, which were then combined to evaluate the overall condition assessment result for the site.

Nine sites passed the Population assessment. The failure at two sites could be linked to drainage activities in parts of the sites. All of the sites received a Favourable assessment for Habitat for the Species, apart from one upland flush site, which failed due to overgrazing of the habitat surrounding the flush.

The Future prospects of the Population and Habitat for the Species parameters were assessed at each site, taking pressures, threats and activities into account. Grazing was recorded at most sites and was usually considered beneficial at appropriate levels, although some poaching and erosion was noted at two sites. Damaging drainage activities were recorded at two sites, but the prospect of recovery is deemed to be good if no further drainage activities take place.

Combining the assessments of the three parameters at each site resulted in ten sites receiving an overall assessment of Favourable, while one site, received an Unfavourable-Inadequate assessment.

At the national level, the Population parameter received a Favourable assessment. Only parts of two sites that failed the Population assessment were negatively affected by drainage and there are good prospects for recovery in these otherwise large populations. Ten of the sites (c. 90%) containing over 99% of the area of the Habitat for the Species achieved a Favourable result for Habitat for the Species, and the Future prospects of Habitat for the Species was assessed as good for the sites deemed to be in Favourable condition. Combining these results, the national conservation status assessment for the Annex II species *Hamatocaulis vernicosus* was then evaluated, and a result of Favourable was obtained.

The report concludes with recommendations for refining the methodology in future monitoring cycles and for improving the conservation status of the less favourably scored sites.

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1 Introduction

1.1 *Hamatocaulis vernicosus*

Hamatocaulis vernicosus Mitt. Hedenäs (Slender Green Feather-moss) is a medium-sized perennial pleurocarpous moss of mesotrophic fens and flushes that forms green to yellowish-green patches and has pinnately branched shoots, with branches that are held *circa* 90° to the stem (Atherton *et al*., 2010). It has distinctive hooked shoot tips (Figure 1) and the leaves are strongly falcate-secund, are often longitudinally plicate and are frequently tinged with red at the bases (Smith, 2004).

The species was known as *Drepanocladus vernicosus* (Mitt.) Warnst. before Hedenäs (1989a) transferred it to *Hamatocaulis*, a new genus. There are two species in the genus, the other species being *H. lapponicus*, a Boreal species that does not occur in Ireland and differs from *H. vernicosus* mainly in its leaf morphology (Hedenäs, 2003; Smith, 2004). *H. vernicosus* can appear similar to other fen species, such as *Warnstorfia exannulata*, but differs in the lack of a central strand and hyalodermis, lack of differentiated alar cells and distinctly plicate leaves (Hedenäs, 1989a, 2003). In the past, it has also been confused with other species, such as *Scorpidium cossonii* and *Palustriella commutata*, which led to many erroneously labelled herbarium specimens (Blockeel, 1997).

H. vernicosus is a dioicous species and sporophytes have never been recorded in Ireland (or Britain) and are very rare across its distribution, maturing in summer where they do occur (Hedenäs, 1989a; Smith, 2004). Specialised vegetative propagules are unknown, thus asexual reproduction through gametophytic fragmentation must be the means of propagation. Fragment dispersal is usually effective only over short distances, unless the fragments are spread by birds or large mammals (Hedenäs, 1989b; Štechová & Kučera, 2007).

H. vernicosus is a widely distributed, but rarely common, circumboreal species ranging from the Arctic, south to western, central and eastern Europe, Turkey, Caucasus, central Asia and northern USA, with a disjunct occurrence in the Dominican Republic (Hill *et al*., 1994).

Hedenäs & Eldenäs (2007) found two clades within the species from DNA sequence analysis. The first clade included specimens from southern Sweden, Denmark, Austria, Switzerland, N. Italy, central Spain, Britain, Russia and Peru, while the second clade was found in specimens from northern Sweden, USA, Poland, S. Sweden, Denmark, Switzerland and Austria. No difference in morphology was discernible between the two clades. It is not known to which clade the Irish populations belong.

In the Republic of Ireland, *H. vernicosus* is protected through listing on the Flora (Protection) Order, 2015 (Statutory Instrument No. 356 of 2015) and is classified as *Near Threatened* (Lockhart *et al*., 2012a, 2012b), with scattered extant populations found in the counties of Cavan, Donegal, Galway, Mayo, Waterford and Westmeath. There are four localities where confirmed records of *H. vernicosus* have been reported, but where the species is now thought to be extinct, or not seen in over 30 years, and there are a number of records that remain unconfirmed in the absence of specimens, and reported finds that are known to be errors of misidentification. These are detailed in Campbell *et al*. (2015).

H. vernicosus is predominantly found in intermediate fens and flushes where there is an influence of mineral-rich, but not calcium-rich, groundwater (Hedenäs, 1989a, 2003; Hodgetts, 2007). It is found in somewhat base-rich springs in upland districts, while in the lowlands it generally occurs in spring-influenced sites in mildly basic small sedge fens (Hill *et al*., 1994). The EU Habitats Directive classification of intermediate fens and flushes is 'Transition mires and quaking bog' (EU Habitat code 7140) and the habitat is given the same name in the Heritage Council classification scheme (Fossitt, 2000; habitat code PF3). In Ireland, this habitat can occur in lowland topogenous depressions, such as at Scragh Bog, Co. Westmeath, and also soligenous types that can occur on valley slopes and hillsides, such as at Meentygrannagh, Co. Donegal. This habitat can be very wet with a quaking surface. In some

cases, a floating raft of sedges and bryophytes develop, with sphagna occurring that are more base-tolerant, e.g. *Sphagnum contortum*, *S. teres* and *S. warnstorfii* (Štechová and Kučera, 2007; McBride *et al*., 2011). The nutrient status of this type of wetland is oligo- to mesotrophic with a basic to slightly basic pH (Raeymaekers, 1999), in the range of 5.0–7.5 (Doyle & Ó'Críodáin, 2003). The habitat can also occur in mosaic with alkaline fen vegetation.

H. vernicosus occurs in upland transition mires and flushes in counties Donegal, Mayo, Waterford and Cavan, and in lowland transition mires/fens and sedge meadows in counties Mayo, Galway and Westmeath. The area covered by the populations range from a few square centimetres, at Rathavisteen, to extensive patches over several thousand square metres, at Scragh Bog, Co. Westmeath.

Figure 1 Shoots of *Hamatocaulis vernicosus* showing hooked tips, almost 90° branching from the main stems and red pigmentation at the base of the leaves on the main stems.

1.2 Rationale for the survey

1.2.1 Article 17 of the EU Habitats Directive

Species of conservation concern in Europe and of European importance are listed under Annexes II, IV and V of the EU Habitats Directive (92/43/EEC). Under Article 11 of the Directive, all EU Member States that are signatories to the Directive have an obligation to undertake surveillance of the conservation status of species deemed to be of Community interest, i.e. those which are listed on Annex II and/or Annex IV or V of the Directive.

Article 17 of the Directive places an obligation on Member States to report on the results of this surveillance and the conservation status of the Annex II species that occur within their boundaries. This requires information on several parameters, including Population, Habitat for the Species and Future Prospects (DG Environment, 2017; see Section 1.2.2 also). These national conservation status assessment reports are produced every six years. The recent round of reporting, covering the period 2013–2018,

was submitted in 2019. This is the third round of reporting carried out under Article 17 where the conservation status is assessed.

The National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht commissioned BEC Consultants Ltd to carry out the Rare Plants Monitoring Survey (RPMS), a three-year survey, conducted from 2015 to 2018, to monitor and assess the conservation status of eight Directive species: the clubmosses *Diphasiastrum alpinum*, *Huperzia selago*, *Lycopodium clavatum* and *Lycopodiella inundata*, all of which are listed on Annex V; *Saxifraga hirculus* and *Vandenboschia speciosa*, listed on Annex II and Annex V; and the Annex II listed bryophytes *Hamatocaulis vernicosus* and *Petalophyllum ralfsii*.

This Irish Wildlife Manual outlines the results of the monitoring survey of the Annex II listed moss *Hamatocaulis vernicosus* which took place from September 2015 to September 2017 as part of the RPMS. The results of the 2015–2017 survey fed into the 2019 Article 17 report on the conservation status of the species in Ireland.

1.2.2 Assessment of Annex II species

Annex II species are assessed under four parameters of conservation status: Range, Population, Habitat for the Species and Future prospects. Guidance on assessment is provided by the EU (DG Environment, 2017). Evaluation of conservation status requires the separate assessment of the four parameters. Each parameter can receive an assessment of Favourable (green), Unfavourable-Inadequate (amber) or Unfavourable-Bad (red). The individual parameter assessments are then combined, with the aid of an evaluation matrix (Table 1), to give an overall national assessment of conservation status for the species.

The 2015–2017 survey assessed three parameters at each site: Population, Habitat for the Species and Future prospects. Range was assessed separately for the final national conservation status assessment report.

Population is assessed by examining the current population size and comparing it with that recorded in previous reporting periods, where this information is available. For the 2001–2006 reporting period, the unit of population size estimation for *Hamatocaulis vernicosus* was 'number of localities' (European Commission, 2006). A locality (which is synonymous with site in this report) was defined as 'a geographical area inhabited by a set of individuals which are able to reproduce or occur on a long-term basis and cover continuous space in a given period'. At that time there were nine known localities, in eight Special Areas of Conservation (SACs), in the Republic of Ireland. During the subsequent reporting period from 2007 to 2012, two additional localities were discovered, giving a total of 11 localities (sites), in nine SACs. For the 2007–2012 reporting period, the agreed unit used for reporting population size of *H. vernicosus* was 'area covered by population in m^2'. This was used instead of the recommended unit 'number of individuals' (Evans & Arvela, 2011) because, for bryophytes, what constitutes an 'individual' is problematic as it could be defined as a single shoot or a large genetically homogenous colony comprising thousands or even millions of individual shoots. For the 2013–2018 reporting period, and to facilitate comparison between EU Member States, the required population size unit for *H. vernicosus* is now the number of occupied 1km x 1km grids (DG Environment, 2017). An additional population size unit can be reported on, chosen from a list of agreed-upon population size units (DG Environment, 2017). For the 2013–2018 reporting period, the additional population size unit chosen for *H. vernicosus* in the Republic of Ireland is 'area covered by the population in m^2'.

To assess the Habitat for the Species parameter for *Hamatocaulis vernicosus* at the sites, the survey methodology follows what has now become standard practice in Ireland of assessing habitats in general, i.e. using monitoring stops (plots). Habitat for the Species is assessed by means of several criteria (devised by each Member State to assess the species according to local conditions) that examine key attributes of the species' habitat and compare the current values with set benchmarks or thresholds that reflect the species' habitat when it is in Favourable condition. The attributes are examined and assessed at a monitoring stop, which is usually a plot of fixed size delimited on the ground using a measuring

tape or quadrat square. The dimensions of the plot and the number of monitoring stops recorded vary depending on the habitat type and the extent of the species occurrence in the site.

Table 1 General evaluation matrix for assessment of Conservation Status (CS) of Annex II species (adapted from DG Environment, 2017).

	Conservation Status			
Parameter	**Favourable ('green')**	**Unfavourable – Inadequate ('amber')**	**Unfavourable - Bad ('red')**	**Unknown**
Range	Stable (loss and expansion in balance) or increasing AND not smaller than the 'favourable reference range'	Any other combination	Large decline: equivalent to a loss of more than 1% per year within period specified by Member State OR more than 10% below 'favourable reference range'	No or insufficient reliable information available
Population	Population(s) not lower than 'favourable reference population' AND reproduction, mortality and age structure not deviating from normal (if data available)	Any other combination	Large decline: equivalent to a loss of more than 1% per year (indicative value Member State may deviate from if duly justified) within period specified by Member State AND below 'favourable reference population' OR more than 25% below 'favourable reference population' OR reproduction, mortality and age structure strongly deviating from normal (if data available)	No or insufficient reliable information available
Habitat for the species	Area of habitat is sufficiently large (and stable or increasing) AND habitat quality is suitable for the long-term survival of the species	Any other combination	Area of habitat is clearly not sufficiently large to ensure the long-term survival of the species OR habitat quality is bad, clearly not allowing long-term survival of the species	No or insufficient reliable information available
Future prospects (with regard to population, range and habitat availability)	Main pressures and threats to the species not significant; species will remain viable on the long-term	Any other combination	Severe influence of pressures and threats to the species; very bad prospects for its future, long-term viability at risk.	No or insufficient reliable information available
Overall assessment of Conservation Status	All 'green' OR three 'green' and one 'unknown'	One or more 'amber' but no 'red'	One or more 'red'	Two or more 'unknown' combined with green or all 'unknown'

The Future prospects assessment at each site requires an examination of the species' stability in terms of its Population and Habitat for the Species in the context of the impacts and activities taking place in the extent of occurrence of the species and across the site as a whole. The balance between positive and negative impacts is weighed up and the Future prospects of the Population and Habitat for the Species at the site over the next two reporting periods (12 years) are evaluated.

1.3 *Hamatocaulis vernicosus* surveys in Ireland

Targeted recording of *Hamatocaulis vernicosus* began in 1998 as part of the NPWS programme of Rare and Threatened Bryophyte surveys. The species has now been recorded at 11 sites (localities) in the following counties: Waterford (three sites); Galway (one site); Westmeath (one site); Mayo (four sites); Donegal (one site); Cavan (one site) (Sources: Lockhart, 1999a, 1999b; Holyoak, 2002; Holyoak, 2003; Holyoak, 2004; Hodgetts, 2007; Perrin *et al*., 2013; NPWS Rare and Threatened Bryophyte database). The most recent discovery of a population of *H. vernicosus* was at Commas, Co. Cavan in 2012 during the National Survey of Upland Habitats (Perrin *et al*., 2013) and it is possible that further populations may yet be unrecorded due to its relatively small size and difficulty in identification.

As part of a PhD study (Campbell, 2013), a detailed field survey of seven of the 11 *H. vernicosus* sites was undertaken in 2009–2011 to record information on population size, structure, associated vegetation and environmental variables. The results of that study were used to produce a monitoring protocol for *H. vernicosus* in the Republic of Ireland which is presented in Campbell *et al*. (2015).

The results of that study were used to inform the Article 17 report on *H. vernicosus* submitted in 2013. The four parameters Range, Population, Habitat for the Species and Future prospects were determined to be Favourable for *H. vernicosus* (NPWS, 2013; Campbell *et al*., 2015). The overall conservation status for the species was therefore determined as Favourable.

As the study (Campbell, 2013; Campbell *et al*., 2015) was a baseline survey, the Population parameter was determined as Favourable because there were no previous fully mapped population extents available with which to make comparisons. Populations were mapped in the field and extent of occurrence polygons were defined based on the locations of a number of geo-referenced *H. vernicosus* locations. As not all of the habitat within the extent of occurrence contained *H. vernicosus*, the mean percentage cover within a number of plots was used to determine the area covered by the population (m^2) within the extent of occurrence at each site. Data on percentage cover and also on shoot density of the species were recorded in the plots to provide targets for future monitoring surveys. From the analysis of data collected, ecological indicators and associated targets were derived to assess the quality condition of each site and a monitoring methodology to assess Habitat for the Species was developed. Habitat for the Species was determined to be Favourable. Future prospects were determined by examining the balance between any negative pressures recorded and activities impacting positively on the Population and Habitat for the Species and were also deemed to be Favourable.

The term 'baseline survey' used in this report hereafter refers to the study carried out by Campbell (2013) and outlined in Campbell *et al*. (2015), which also provided the monitoring protocol which set targets for the parameter assessments that are used in this report.

1.4 The 2015–2017 survey

NPWS commissioned BEC Consultants to carry out the survey detailed in this report. The aims of the survey that relate to this report, as set out by NPWS, were as follows:

- Undertake the monitoring of the conservation status of all 11 known sites for *Hamatocaulis vernicosus* in the Republic of Ireland using the methodology outlined in Campbell *et al*. (2015);
- Undertake full surveys following the methodology used in Campbell (2013) at four of the 11 sites that had not been surveyed by Campbell (2013); and

- Complete a National Conservation Status Assessment (NCA) and audit trail for the species using the latest available European Commission and NPWS guidance.

The survey was required to gather assessment data on all 11 known *Hamatocaulis vernicosus* sites in the Republic of Ireland. Data from the 11 sites surveyed during the 2015–2017 survey were used to evaluate the current national conservation status of *Hamatocaulis vernicosus* in Ireland. The assessment process will be outlined in this report.

2 Methodology

2.1 Site selection

All 11 *Hamatocaulis vernicosus* sites in the Republic of Ireland were selected for survey by NPWS prior to commencement of the RPMS. Seven of the sites had been surveyed during the baseline survey (Campbell, 2013; Campbell *et al*., 2015) and these were selected for monitoring of assessment attributes (see Section 2.3). The four other sites were also included for full surveys (see Section 2.3) similar to that previously carried out by Campbell (2013) at the seven other sites. The site names used throughout this report correspond to those used in Campbell *et al*. (2015), as do the site codes, but with the prefix 'Hv0'. The 11 sites containing extant populations of *Hamatocaulis vernicosus* in the Republic of Ireland, occurring within nine SACs, that were targeted during the 2015–2017 survey are listed in Table 2. Figure 2 shows the 2015–2017 survey locations superimposed on the national 10km distribution map of *Hamatocaulis vernicosus* from the 2007–2012 Article 17 report (NPWS, 2013).

Table 2 The site code and site name of each of the 11 *Hamatocaulis vernicosus* sites surveyed, and the county, the Special Area of Conservation (SAC) name and SAC code in which they occur, and type of survey carried out during the 2015–2017 survey.

Site code	Site name	County	SAC name	SAC code	Type of survey
Hv01	Meentygrannagh	Donegal	Meentygrannagh Bog	IE0000173	Monitoring
Hv02	Rathavisteen	Mayo	Glenamoy Bog Complex	IE0000500	Full survey
Hv03	Largan More	Mayo	Carrowmore Lake Complex	IE0000476	Monitoring
Hv04	Uggool	Mayo	Owenduff/Nephin Complex	IE0000534	Full survey
Hv05	Owenbrin	Mayo	Lough Carra/Mask Complex	IE0001774	Monitoring
Hv06	NW of Gortachalla Lough	Galway	Lough Corrib	IE0000297	Monitoring
Hv07	Scragh Bog	Westmeath	Scragh Bog	IE0000692	Monitoring
Hv08a	Below Sgilloge Loughs	Waterford	Comeragh Mountains	IE0001952	Monitoring
Hv08b	Nier River Valley	Waterford	Comeragh Mountains	IE0001952	Monitoring
Hv08c	Coumtay	Waterford	Comeragh Mountains	IE0001952	Full survey
Hv09	Commas	Cavan	Cuilcagh-Anierin Uplands	IE0000584	Full survey

The seven sites previously surveyed by Campbell (2013) are Hv01 Meentygrannagh, Hv03 Largan More, Hv05 Owenbrin, Hv06 NW of Gortachalla Lough, Hv07 Scragh Bog, Hv08a Below Sgilloge Loughs and Hv08b Nier River Valley. *H. vernicosus* was recorded at the remaining sites during NPWS Rare and Threatened Bryophyte surveys at Hv02 Rathavisteen (Lockhart, 1999a), Hv04 Uggool (Lockhart, 1999b) and Hv08c Coumtay (Hodgetts, 2007), and during the National Survey of Upland Habitats at Hv09 Commas in 2012 (Perrin *et al*., 2013). Details of all sites can also be found in Campbell *et al*. (2015).

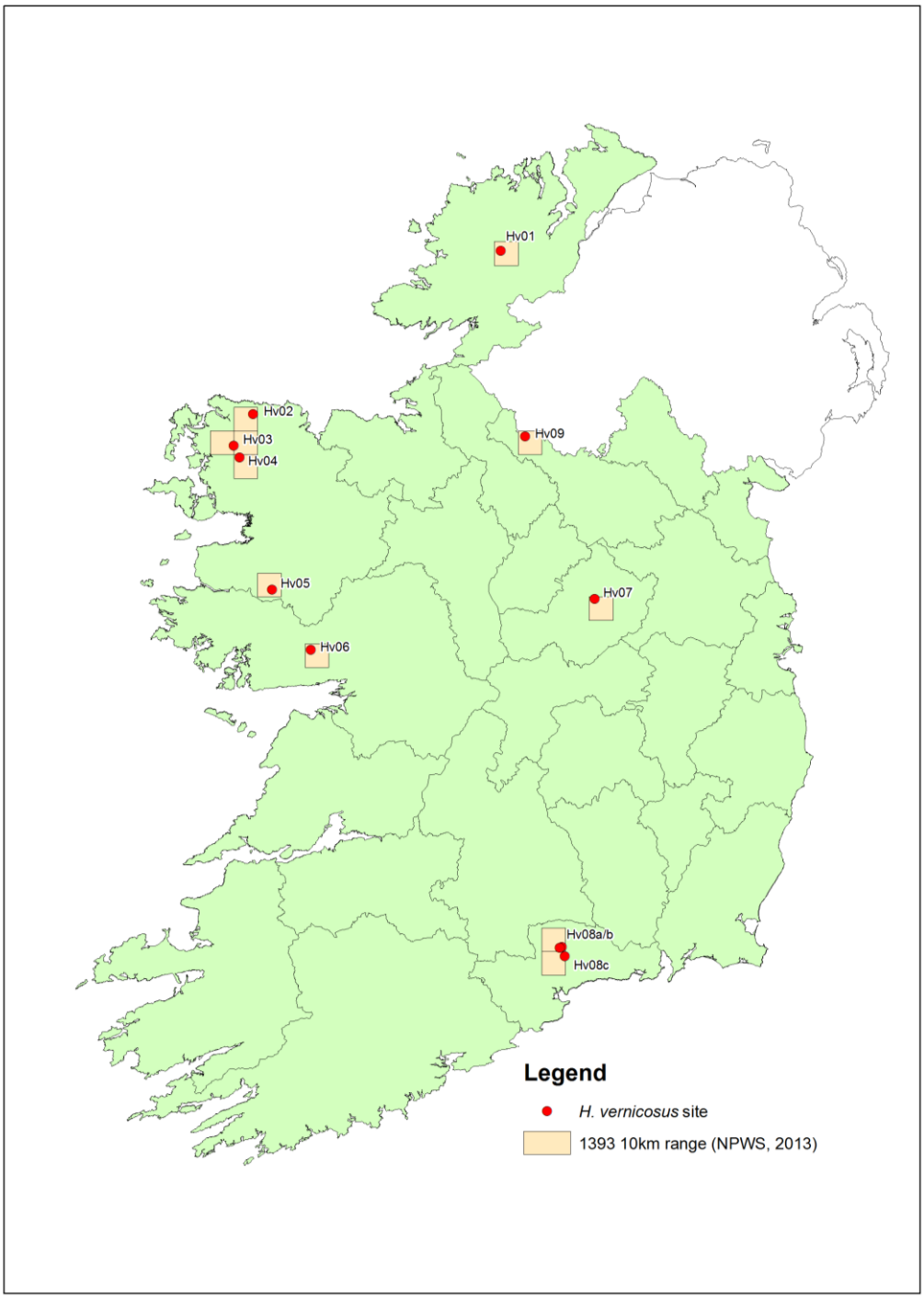

Figure 2 Location of sites for the *Hamatocaulis vernicosus* monitoring survey 2015–2017 overlaid on to the national 10km distribution of the species from the last round of reporting 2007–2012 (NPWS, 2013) when the species was reported on as *Drepanocladus vernicosus* (species code 1393). See Table 2 for site code key and further site details.

2.2 Survey preparation

2.2.1 Site packs

A site pack was set up for each site containing the baseline site report produced by Campbell *et al*. (2015) and a field map consisting of an aerial photograph of the site with the population envelope boundary outlined on it. A blank site summary data sheet was also included in the pack, to be completed by the ecologists at the end of the site survey (see Appendix 1).

The NPWS Ranger in whose jurisdiction the site was located was contacted in advance of the survey. As *Hamatocaulis vernicosus* is listed on the Flora (Protection) Order, 2015, a licence was obtained from NPWS that allowed collection of material for identification purposes, if necessary, and for voucher specimens.

2.2.2 Trimble Nomads

Hand-held Trimble Nomads were set up to record GPS waypoints in ArcPad and to record monitoring stop and vegetation data in Turboveg CE (Alterra, The Netherlands). A shapefile containing GIS data recorded during previous surveys (Campbell, 2013; NPWS Rare and Threatened Bryophyte surveys; Perrin *et al*., 2013) was uploaded onto the Trimble Nomads to enable the surveyors to navigate directly to site polygons and monitoring stops.

2.3 Site surveys

Sites were surveyed in August/September of 2015, 2016 and 2017. Late summer/autumn was chosen as the optimal time for surveying as *Hamatocaulis vernicosus* can produce sporophytes at this time of year where the species is known to sexually reproduce elsewhere in Europe. JNCC monitoring guidelines recommend late summer/autumn for visits to fen/mire sites as higher plant species, particularly sedges, are easier to identify at this time (Joint Nature Conservation Committee, 2004). Gametangia are more likely to be present on the shoots at this time also (Campbell, 2013). Survey teams consisted of a minimum of two ecologists.

During all stages of the survey, surveyors recorded any information of interest or relevance, including features or species of interest, botanical or otherwise. Where possible, these were photographed. Notable plant species (e.g., FPO, Red List) were recorded and a grid reference taken for inclusion in the project's Recorder Excel spreadsheet. Photographs of site features (e.g. impacts, management) were taken as appropriate for inclusion in the project's Image Databank.

The survey methodology can be broadly divided into three main tasks:

- Establish and map the extent of occurrence of the population in the site;
- Record monitoring/full survey data at 'monitoring stops';
- Complete the site summary data sheet including impact recording.

2.3.1 Mapping extent of occurrence and area covered by the population

The extent of occurrence (population envelope measured in m^2) of each *Hamatocaulis vernicosus* population at all 11 known sites was delimited with the aid of GPS waypoints recorded on the hand-held Trimble Nomad. The baseline survey polygons and previously recorded GPS points at all sites were used as a guideline. The area covered by the population (m^2) within the extent of occurrence was then estimated by multiplying the mean cover of *H. vernicosus* (as measured in the 2m x 2m monitoring stops recorded at each site) by the area of the extent of occurrence. The area covered by the population

is essentially the area of occupancy of *H. vernicosus* within the extent of occurrence, as not all microhabitats within the extent of occurrence are suitable for *H. vernicosus*.

The terminology of 'area covered by the population (m^2)' is used as it is the additional population size unit chosen for Article 17 reporting (DG Environment, 2017). As it is not clear why *H. vernicosus* is present in some microhabitats and not in other apparently suitable microhabitats in a site, the area covered by the population (m^2) figure is also used as the area of suitable habitat figure and is also referred to as 'area covered by the population' in the Habitat for the Species assessment.

2.3.2 Monitoring stop recording

Monitoring stops consisted of plots measuring 2m x 2m ($4m^2$) that were delineated on the ground using a tape measure and tent pegs. The term 'monitoring stop' is used for both monitoring plots and full survey plots where additional information was recorded (see Section 2.3.3). Appendix 2 gives the full list of data items recorded in Turboveg at each monitoring stop.

At each monitoring stop, a GPS waypoint was recorded on the Trimble Nomad and photographs were taken, including at least one close-up overview of the stop and another more general view to show the stop in the context of the landscape. At the four full survey sites, an overview photograph and photographs taken facing north, south, east and west were taken at each monitoring stop.

The number of monitoring stops recorded depended on the area of the extent of occurrence and ranged from one to seven plots per site. Monitoring stops were recorded where plots had been recorded at the seven sites previously surveyed by Campbell (2013; Campbell *et al*., 2015) and relocated using GPS point information.

The following data were recorded at each monitoring stop for the Population/Habitat for the Species assessments:

- Percent cover of *Hamatocaulis vernicosus* in the monitoring stop
- Number of shoots of *H. vernicosus* in an area of 10m x 10cm within the stop
- Percent tree cover in the stop
- Percent shrub cover in the stop
- Percent grass cover in the stop
- Percent bryophyte cover in the stop
- Percent cover of *Calliergonella cuspidata* in the stop
- Mean vegetation height (mean height of 5 stems measured in cm) in the stop
- Whether hand was covered by water when pressed into the vegetation in the stop, recorded as Yes or No

Mean water depth (mean depth taken at 5 points) in the plot was recorded at each monitoring stop, but this information was not used in the assessment. Percent cover of the associated species in each stop was also recorded for information purposes, but again was not used in the assessment.

2.3.3 Additional full survey site information

At the four sites for full survey, in addition to the monitoring data to inform the Population and Habitat for the Species assessments, full relevés recording other structural data, such as the cover of sedges, rushes, fern/fern allies, etc. and of individual associated species, were completed at each monitoring stop. Appendix 2 gives the full list of data items recorded in Turboveg at each monitoring stop in the four full survey sites.

Water samples were also collected from each monitoring stop in the full survey sites for analysis of pH, conductivity (µS/cm), ammonium (mg l^{-1}), nitrate (mg l^{-1}), orthophosphate (mg l^{-1}) and total phosphate

(mg l^{-1}). The samples were analysed by Fitz Scientific Laboratory in Drogheda, Co. Louth. Ammonium, nitrate, orthophosphate and total phosphate were analysed using the colorimetry analytical technique.

Where availability of the species allowed, samples of shoots were taken from various locations within the monitoring stops at the full survey sites for determination of sex ratios. While the presence of gametangia on shoots can be determined in the field with a hand lens, whether or not they contained archegonia or antheridia can only be established through examination under a microscope. The collected shoots were taken back to the laboratory. On female shoots, perichaetical leaves require removal to reveal red flask-shaped archegonia. Male gametangia appear somewhat larger and rounder than female shoots in general, but still require dissection under the microscope to uncover the presence of sac-like antheridia. If a gametangium could not be verified as male or female, particularly in cases where it occurred further down the stem, it was noted as indeterminate. Each shoot collected (to a maximum of 100 per sample) from each sampled plot was examined under the microscope, noted as male, female, indeterminate or sterile (no gametangia present) and percentages of each category were calculated per sample.

2.3.4 Site summary data

Surveyors completed a site summary data sheet (see Appendix 1) at the end of each site's survey. This allowed surveyors to give general descriptive information about the site, including their overall impression of the site, and any impacts or management taking place that might affect the Population and/or Habitat for the Species. Any changes since the baseline survey were noted and described. Impacts and activities were recorded with the impact code (Ssymank, 2011), magnitude, influence, and percentage of the extent of occurrence affected. Data from the site summary data sheets are presented in Appendix 3 as brief site reports.

The following site summary information was derived based on field mapping and data from the monitoring stops:

- *Extent of occurrence:* The extent of occurrence (m^2) was derived from GIS after field maps had been digitised in the office. This delineates the extent of the area within which the species occurs at the sites.
- *Percent cover of* H. vernicosus: The percentage cover of *H. vernicosus* was calculated by averaging the percentage cover of *H. vernicosus* in the 2m x 2m monitoring stops across the site.
- *Area covered by the population (m^2)*: This is calculated by multiplying the extent of occurrence (m^2) by the mean percentage cover of *H. vernicosus*.
- *Density of shoots/m^2*: In order to estimate the density of *H. vernicosus* in each population, the number of shoots within a 10cm x 10cm area ($100cm^2$) within each monitoring stop was counted. The mean number recorded in the stops was extrapolated to a mean number per m^2 in the site.
- *Population estimate (shoots)*: The density of shoots/m^2 figure was then multiplied by the area covered by the population (m^2) to give a shoot count per population. It must be borne in mind, however, that the number of shoots does not necessarily correspond to the number of genetically distinct individuals.
- *Impacts and activities:* Any impacts/activities negatively affecting the condition of the species population and its habitat, such as overgrazing or drainage, were noted, including the percentage of the extent of occurrence affected and the intensity of the impact (high, medium or low). The same data were recorded for any activities judged to be having a beneficial effect on the species population and its habitat.

- *Site summary/Management:* A brief summary was written for each site, including notes on the general condition of the species population and its habitat, site management, and any pressures and threats observed.
- *Other site-level data:* Any other information of interest or relevance was noted, including any features or species of interest, botanical or otherwise.

2.4 Assessments

2.4.1 Population assessment

For the 2007–2012 reporting period, the agreed unit for estimating population size of *Hamatocaulis vernicosus* was 'area covered by the population in m²' (Evans & Arvela, 2011). As the RPMS began before the new guidelines for the 2013–2018 period (DG Environment, 2017) were available, this unit was measured during the 2015–2017 monitoring survey.

As area covered by the population in (m²) was calculated by multiplying the extent of occurrence (m²) by the mean percentage cover of *H. vernicosus*, targets for these two attributes were set by Campbell *et al*. (2015) at the seven sites surveyed by Campbell (2013). The targets were set at a minimum of 80% of the results obtained by Campbell (2013) in order to allow for a margin of error in GPS mapping, variability within sites and recording error. The targets for extent of occurrence (m²) at the four remaining sites were set at 80% of the extent noted by the recorder at each site during the NPWS Rare and Threatened Bryophyte surveys. Targets for percentage cover of *H. vernicosus* at these four sites could not be set, as this information was absent.

Targets for shoot density were also set by Campbell *et al*. (2015) at the seven sites surveyed by Campbell (2013). The targets were set at a minimum of 80% of the results obtained by Campbell (2013) in order to allow for a margin of error and variability within plots. Targets for shoot density at the four remaining sites could not be set, as this information was absent.

The Population assessment is summarised in Table 3.

Table 3 Summary of the Population assessment for *Hamatocaulis vernicosus* followed during the 2015–2017 monitoring survey (adapted from Campbell *et al*., 2015)

Attribute	Method of assessment	Target for pass at site level
Extent of occurrence (m²)	Area of polygon(s) delineating the extent of occurrence	Site dependent; a minimum of 80% of the previously mapped extent
Mean percent cover of *H. vernicosus*	Percent cover in a representative number of 2m x 2m monitoring plots	Site dependent; a minimum of 80% of the previously recorded mean cover
Mean density of shoots/m²	No. of shoots/100cm² extrapolated to per m² in a representative number of 2m x 2m monitoring plots	Site dependent; a minimum of 80% of the previously recorded mean density
Population assessment*		Favourable = 2-3 attributes pass
		Unfavourable-Inadequate = 1 attribute passes
		Unfavourable-Bad = 0 attributes pass

*only the extent of occurrence attribute was required to pass in order to achieve a Favourable assessment at the four sites where no cover or density information was available.

The targets for area covered by the population (m^2) at the seven sites surveyed by Campbell (2013) were determined by Campbell *et al*. (2015) by multiplying the extent of occurrence (m^2) with the mean area of *H. vernicosus* recorded in the plots, both reduced by 20% in order to allow for margin of error in GPS mapping, variability within sites and recording error. Targets for the area covered by the population (m^2) at the four remaining sites could not be set as there was no information on mean percentage cover of *H. vernicosus* at these sites. The area covered by the population (m^2) result at each site was used in the Habitat for the Species assessment (see Section 2.4.2) as there is complete overlap of area covered by the population with area of suitable habitat.

The area covered by the population (m^2) results from all sites were summed to give a national total which was used as the additional population size unit when reporting on the conservation status of Population in the 2013–2018 reporting period.

The population size unit required for reporting under Article 17 for the 2013–2018 reporting period is number of 1km x 1km grids (DG Environment, 2017). To estimate this, the extent of occurrence polygons (population envelopes) recorded during the 2015–2017 survey at all 11 *H. vernicosus* sites were intersected with the Irish National Grid (ING) 1 km square grid using ArcGIS.

2.4.2 Habitat for the Species assessment

The area covered by the population (m^2) result at each site (see Section 2.4.1) was used in the Habitat for the Species assessment as there is complete overlap of area covered by the population with area of suitable habitat for *H. vernicosus*.

Analysis of data collected during surveys at seven *H. vernicosus* sites by Campbell (2013) suggested positive and negative indicators (attributes) to monitor the quality of the habitat for *H. vernicosus*. These are outlined in Campbell *et al*. (2015) and were used to assess the quality of the Habitat for the Species. These attributes are hydrology, tree cover (%), shrub cover (%), grass cover (%), bryophyte cover (%), cover of *Calliergonella cuspidata* (%) and mean vegetation height (cm). These were recorded within the 2m x 2m monitoring stops.

The attributes were recorded at the monitoring stop level and averaged across the stops to obtain a pass or fail at a site level for each attribute. The Habitat for the Species assessment for the site was based on the number of attributes that passed for the site as a whole. A summary of the assessment procedure is shown in Table 4.

Expert judgement could be allowed to pass a marginally failing attribute where deemed appropriate, e.g. all other attributes were passing, there were no obvious anthropogenic causes for failure, prior knowledge of the site.

2.4.3 Future prospects assessment

EU guidance states that the species' Future prospects parameter "*should be evaluated by individually assessing the expected future trends and subsequently future prospects of each of the other three parameters* [Range, Population and Habitat for the Species], *taking primarily into account the current conservation status of the parameter, threats (related to the parameter assessed) and the conservation measures being taken or planned for the future. Once the future prospects of each of the other three parameters have been evaluated, they should be combined to give the overall assessment of Future prospects*" (DG Environment, 2017).

Future prospects were assessed at the site level by evaluating the future prospects and future expected trend of Population and Habitat for the Species at each site, and examining the current pressures, future threats and beneficial management practices operating on the site. Guidance provided by the EU (DG Environment, 2017) was followed to determine the future trends and future prospects of each parameter.

Table 4 Summary of the Habitat for the Species assessment for *Hamatocaulis vernicosus* followed during the 2015–2017 survey (based on Campbell *et al.*, 2015).

Attribute	Method of assessment	Target for pass at site level
Area covered by the population (m^2)	Multiply extent of occurrence by mean % *H. vernicosus* cover in a representative number of monitoring plots	Site dependent; for the four sites where cover information is lacking, the extent of occurrence target is the target set
Hydrology	Hand should be pressed into vegetation	Water level should cover hand when pressed into the vegetation
Tree cover (%)	Percent cover in a representative number of 2m x 2m monitoring plots	Mean percent tree cover should not exceed 15%
Shrub cover (%)	Percent cover in a representative number of 2m x 2m monitoring plots	Mean percent shrub cover should not exceed 20%
Grass cover (%)	Percent cover in a representative number of 2m x 2m monitoring plots	Mean percent grass cover should not exceed 25%
Bryophyte cover (%)	Percent cover in a representative number of 2m x 2m monitoring plots	Mean percent bryophyte cover should exceed 50%
Cover of *Calliergonella cuspidata* (%)	Percent cover in a representative number of 2m x 2m monitoring plots	Mean percent cover of *C. cuspidata* should not exceed 15% (60% in Hv07 Scragh Bog)
Mean vegetation height (cm)	Centimetres in a representative number 2m x 2m monitoring plots	Mean vegetation height should not exceed 40cm (80cm in Hv07 Scragh Bog)
Habitat for the Species assessment		Favourable = 7–8 attributes pass
		Unfavourable-Inadequate = 5–6 attributes pass
		Unfavourable-Bad = 0–4 attributes pass

For *Hamatocaulis vernicosus* to be assessed as having Favourable Future prospects, its prospects had to be judged to be good, with no severe impacts expected from threats and the Population and Habitat for the Species expected to be stable or improving in the long-term. For it to be assessed with Unfavourable-Bad Future prospects, its prospects were judged to be bad, with severe impacts expected from threats and the Population and Habitat for the Species expected to decline or disappear in the long term. An assessment of Unfavourable-Inadequate Future prospects was between these two extremes.

To help evaluate Future prospects according to the above guidance, the pressures, threats and positive activities occurring on each site were recorded according to the impact codes of Ssymank (2011) (the 2017 impact codes were not available at the commencement of the RPMS). The magnitude of the impact (high, medium or low), influence (positive, negative or neutral) and percentage area of the extent of occurrence affected were also noted. How positive activities and negative pressures balanced out across each site was examined.

2.4.4 Overall conservation assessment

The overall conservation status assessment for the species at each site was evaluated based on the results of all three parameters, according to the evaluation matrix in Table 1 and using the guidance provided by the EU (DG Environment, 2017).

3 Results

3.1 Overall results

3.1.1 Sites surveyed during the 2015–2017 survey

All known sites for *Hamatocaulis vernicosus* in the Republic of Ireland were surveyed in September 2015, August 2016 and September 2017. Four sites not visited during the survey by Campbell (2013) were surveyed fully and the remaining seven were monitored. Table 5 lists details of the sites surveyed, the type of survey carried out at the sites, the number of monitoring stops (plots) recorded in each site and the 1km x 1km grid squares within which the extent of occurrence polygons fall.

Table 5 Details of the 11 *Hamatocaulis vernicosus* sites surveyed in 2015–2017 listing site code, sites name, county, the type of survey completed at the site, the number of monitoring stops (plots) recorded and the 1km x 1km grids within which the extent of occurrence of the species fall.

Site code	Site name	County	Type of survey	No. of plots	1km x 1km grid
Hv01	Meentygrannagh	Donegal	Monitoring	5	C0205; C0206
Hv02	Rathavisteen	Mayo	Full survey	1	F9837
Hv03	Largan More	Mayo	Monitoring	4	F8923; F9023; F9024
Hv04	Uggool	Mayo	Full survey	3	F9218
Hv05	Owenbrin	Mayo	Monitoring	4	M0662; M0663
Hv06	NW of Gortachalla Lough	Galway	Monitoring	4	M2237
Hv07	Scragh Bog	Westmeath	Monitoring	7	N4258; N4259
Hv08a	Below Sgilloge Loughs	Waterford	Monitoring	4	S2811; S2812
Hv08b	Nier River Valley	Waterford	Monitoring	2	S2711
Hv08c	Coumtay	Waterford	Full survey	2	S2907; S2908
Hv09	Commas	Cavan	Full survey	3	H1227; H1327

3.1.2 Extent of occurrence

Table 6 shows the extent of occurrence in square metres recorded at each site between 2015 and 2017 compared with the extent of occurrence mapped/noted during previous surveys (Perrin *et al.*, 2013; Campbell, 2013; Campbell *et al.*, 2015; NPWS Rare and Threatened Bryophyte surveys) with a reason for change given in the Notes column.

The extent of occurrence increased at Hv01 Meentygrannagh due to additional colonies being found, but this is thought to be due to increased search effort and not a genuine expansion of the population at the site. New colonies were also found at Hv05 Owenbrin that extended the previously mapped extent, but the overall area of extent of occurrence decreased due to more accurate mapping. Similarly, at Hv06 NW of Gortachalla Lough, new colonies were found in the north of the site, but the overall extent of occurrence decreased due to more accurate mapping. A new colony was also found at Hv03 Largan More in a flush where *H. vernicosus* was previously unrecorded, but overall, the area of extent of occurrence decreased at this site due to tighter mapping of the flushes in the site. Because at Hv07 Scragh Bog, the species occurs all throughout the site, both in large swathes and as scattered occurrences, it was

decided to include more of the site within the extent of occurrence. Again, this is not due to a genuine expansion of the population.

Table 6 The extent of occurrence (m²) at the 11 *Hamatocaulis vernicosus* sites surveyed in 2015–2017 and comparison with that recorded in previous surveys (baseline).

Site code	Site name	Extent of occurrence (m²)		Notes
		Baseline	2015-17 survey	
Hv01	Meentygrannagh	3,097	12,302	New colonies found
Hv02	Rathavisteen	10	57	Full survey mapping
Hv03	Largan More	1,593	1,202	New colonies found; more accurate mapping
Hv04	Uggool	1	420	Full survey mapping
Hv05	Owenbrin	11,273	10,620	New colonies found; more accurate mapping
Hv06	NW of Gortachalla Lough	6,209	5,850	New colonies found; more accurate mapping
Hv07	Scragh Bog	59,442	81,574	Difference in mapping
Hv08a	Below Sgilloge Loughs	11,338	7,119	More accurate mapping
Hv08b	Nier River Valley	1,386	1,556	More accurate mapping
Hv08c	Coumtay	1	64	Full survey mapping
Hv09	Commas	2	748	Full survey mapping

3.1.3 Identification of male and female gametangia in full survey sites

Shoot collection for gametangia sex identification from two of the full survey sites, Hv02 Rathavisteen and Hv08c Coumtay, could not take place as the populations at these sites were so small it would be damaging to collect shoots. However, no gametangia were observed on the shoots at these sites. The results of the gametangia identification of shoots sampled at Hv04 Uggool and Hv09 Commas show that the majority of the shoots per sample were males (see Table 7).

Table 7 Details of the percentage male, female, indeterminate and sterile shoots sampled at the monitoring stops in Hv04 Uggool (in monitoring stops Hv04_01–Hv04_03) and at Hv09 Commas (in stops Hv09_01–Hv09_03); n=100 shoots per sample.

Site code and stop number	Hv04_01	Hv04_02	Hv04_03	Hv09_01	Hv09_03	Hv09_03
Percentage male shoots	62%	75%	96%	67%	88%	87%
Percentage female shoots	0%	0%	0%	0%	0%	0%
Percentage indeterminate shoots	0%	1%	0%	0%	0%	0%
Percentage sterile shoots	37%	24%	4%	33%	22%	23%

All sampled shoots where the sex of the gametangia was determined were male at both sites. All remaining shoots were sterile, i.e. they lacked gametangia, or the sex of the gametangium could not be determined.

3.1.4 Results of water sample analysis in full survey sites

Water samples collected at monitoring stops within the four sites for full survey were analysed by Fitz Scientific Laboratory for pH, conductivity (µS/cm), ammonium (mg l^{-1}), nitrate (mg l^{-1}), orthophosphate (mg l^{-1}) and total phosphate (mg l^{-1}). The results are shown in Table 8 which also shows the ranges and

mean of pH, conductivity, ammonium, nitrate, orthophosphate and total phosphate recorded at the seven sites surveyed by Campbell (2013).

Table 8 Results of surface water sample analysis for pH, conductivity (Cond.; µS/cm), ammonia (Amm.; mg l^{-1}), nitrate (mg l^{-1}), ortho-phosphate (OP; mg l^{-1}) and total phosphate (TP; mg l^{-1}) from the monitoring stop at Hv02 Rathavisteen, the three stops at Hv04 Uggool, the two stops at Hv08c Coumtay and the three stops at Hv09 Commas. The '<' prefix denotes the sample was below the detection limit figure.

Parameter	Baseline range (*n*=31)	Baseline mean (*n*=31)	Hv02_01	Hv04_01	Hv04_02	Hv04_03	Hv08c_01	Hv08c_02	Hv09_01	Hv09_02	Hv09_03
pH	5.1–6.8	5.9	6.3	7.3	7.1	5.6	7.5	7.4	7.5	6.3	6.4
Cond.	23.5–526	163	103.4	60.3	46.1	51.1	49.7	44.9	153.6	52.4	83.8
Amm.	0.01–0.20	0.06	<0.01	<0.01	<0.01	<0.01	0.358	0.023	0.013	<0.01	<0.01
Nitrate	0.09–5.35	0.33	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11
OP	0.005–0.083	0.015	<0.01	<0.01	<0.01	0.357	<0.01	<0.01	<0.006	<0.006	<0.006
TP	0.011–0.408	0.083	0.035	0.035	0.084	0.392	0.209	0.035	0.053	0.065	0.138

The majority of the surface water analysis results were within the ranges obtained during the baseline survey (Campbell, 2013; Campbell *et al*., 2015). However, pH was higher at most stops sampled than during the baseline survey. One stop at Hv04 Uggool (Hv04_03) had a high total and ortho-phosphate result. This stop had a lower pH than the other two stops in the site. A high level of ammonia was detected in one of the stops recorded at Hv08c Coumtay (Hv08c_01); this stop also had a relatively high total phosphate level, although the latter was within the range obtained during the baseline survey.

3.2 Population assessment

The required population size unit required for the Population assessment is 'number of occupied 1km x 1km grids' in the 2013–2018 reporting period (DG Environment, 2017). The number of 1km x 1km grids within which *H. vernicosus* occurred during the 2007–2012 reporting period was 17. The number of 1km x 1km grids reported in the 2013–2018 period is 19 (see Table 5). The two extra 1km x 1km grid squares reported are due to full recording of the extent of occurrence at two sites where complete surveys had not previously been carried out (at Hv08c Coumtay, Co. Waterford and Hv09 Commas, Co. Cavan).

Assessment of the Population parameter during the 2015–2017 survey was carried out using the set of attributes and targets set by Campbell *et al*. (2015) and outlined in Table 3 and the results are shown in Table 9. Table 9 shows the extent of occurrence (m^2), the mean percent cover of *H. vernicosus* and the shoot density (no. of shoots/m^2) recorded during the 2015–2017 survey and the targets set for these attributes by Campbell *et al*. (2015). Whether the attribute passed or failed is noted and the overall Population assessment for each site is given.

Targets set for extent of occurrence were allowed to pass on expert judgement at Hv03 Largan More and Hv05 Owenbrin as the decrease was due to more accurate mapping and not loss in area of extent of occurrence. Targets set for mean cover of *H. vernicosus* failed at Hv07 Scragh Bog (marginal fail of 1%) and Hv08b Nier River Valley (failure of 5%). These were allowed to pass on expert judgement as there are no anthropogenic causes for loss in cover and the results may be due to variability within the site and slight differences in plot placement between surveys.

Table 9 Extent of occurrence (m²), mean % cover of *Hamatocaulis vernicosus* and density (shoots/m²) at the 11 sites surveyed during the 2015–2017 survey and comparison with the targets set in Campbell *et al*. (2015); Fav = 2–3 attributes passed; Unfav-In = 1 attribute passed.

Site code	Extent of occurrence (m²)			Mean percent cover of *H. vernicosus* (%)			Density (shoots/m²)			Population assessment
	Target	2015-17 survey	Result	Target	2015-17 survey	Result	Target	2015-17 survey	Result	
Hv01	2,450	12,302	Pass	15	7.7	Fail	8,000	6,000	Fail	Unfav-In
Hv02	8	57	Pass	NA	0.3	NA	NA	900	NA	Fav
Hv03	1,270	1,202	Pass*	24	32	Pass	6,500	12,900	Pass	Fav
Hv04	0.032	420	Pass	NA	28	NA	NA	15,200	NA	Fav
Hv05	9,010	10,620	Pass	40	58	Pass	15,000	12,400	Fail	Fav
Hv06	4,960	5,850	Pass	45	36	Fail	32,500	23,900	Fail	Unfav-In
Hv07	47,550	81,574	Pass	20	19	Pass*	14,500	26,800	Pass	Fav
Hv08a	9,070	7,119	Pass*	25	35	Pass	12,500	14,400	Pass	Fav
Hv08b	1,100	1,556	Pass	40	35	Pass*	29,000	41,000	Pass	Fav
Hv08c	0.8	64	Pass	NA	4	NA	NA	5,000	NA	Fav
Hv09	1.6	748	Pass	NA	32	NA	NA	16,700	NA	Fav

*Allowed to pass on expert judgement

Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough are assessed as Unfavourable-Inadequate as the percentage cover of *H. vernicosus* and shoot density targets were not met at both sites. This can be linked to damaging drainage activities affecting parts of the sites. One of the monitoring plots in the north of the extent of occurrence at Hv06 NW of Gortachalla Lough had a higher cover of *H. vernicosus* than recorded during the baseline survey so it is clear that not all of the site is affected. This is discussed further in Section 4.1.2.

Table 10 shows the area covered by the population recorded during the previous surveys (the extent of occurrence figures are used for the four sites where area covered by the population data are absent), the targets set by Campbell *et al*. (2015) and the area covered by the population recorded during the 2015–2017 survey at each site.

All sites passed the area covered by the population assessment (which is part of the Habitat for the Species assessment, see Section 3.3), apart from Hv06 NW of Gortachalla Lough. Hv02 Rathavisteen was allowed to pass on expert judgement as the area covered by the population target is the extent recorded by Lockhart (1999a) and cover within that was lower (although the exact figure is unknown).

The total of 28,494m² is the 'area covered by the population in m²' figure, the additional population size unit reported for the 2013–2018 Article 17 reporting period.

Table 10 The area covered by the population (m²) at the 11 *Hamatocaulis vernicosus* sites surveyed in 2015–2017 and comparison with that recorded in the baseline survey (Campbell, 2013; Campbell *et al*., 2015).

Site number	Site name	Area covered by the population (m²)			
		Baseline	Target	2015–17 survey	Pass/Fail
Hv01	Meentygrannagh	619	365	947	Pass
Hv02	Rathavisteen	10	8	0.17	Pass*
Hv03	Largan More	478	305	385	Pass
Hv04	Uggool	0.04	0.032	118	Pass
Hv05	Owenbrin	5,637	3,600	6,160	Pass
Hv06	NW of Gortachalla Lough	3,725	2,230	2,106	Fail
Hv07	Scragh Bog	17,833	9,510	15,499	Pass
Hv08a	Below Sgilloge Loughs	3,401	2,265	2,492	Pass
Hv08b	Nier River Valley	762	440	545	Pass
Hv08c	Coumtay	1	0.8	2.6	Pass
Hv09	Commas	2	1.6	239	Pass
	Totals	32,468		28,494	

*Allowed to pass on expert judgement

3.3 Habitat for the Species assessment

The 'area covered by the population' attribute is used in the Habitat for the Species assessment as well as the Population assessment, as area covered by the population is equivalent to the area of suitable habitat for the species.

Assessment of the Habitat for the Species parameter during the 2015–2017 survey was carried out using the attributes and targets set by Campbell *et al*. (2015) which are outlined in Table 4. The assessment includes the results of the 'area covered by the population (m²)' attribute which are outlined in Table 10. A summary of the Habitat for the species assessment results is shown in Table 11. All the sites passed the Habitat for the Species assessment apart from Hv08c Coumtay which failed on mean grass cover (marginal fail of 2.5%), mean bryophyte cover and mean cover of *Calliergonella cuspidata*. The area covered by the population at this site is 2.6m² which is <0.0001% of the national total and so Habitat for the Species is assessed as Favourable at a national level.

3.3.1 Hydrology

Each site passed this attribute, apart from Hv05 Owenbrin where the level of the water table in each monitoring stop ranged from 55cm to more than 70cm below the level of the ground surface. It was deemed to pass on expert judgement for hydrology as this site occurs on the shores of Lough Mask and is subject to periodic inundation and large water level fluctuations. Similar results were obtained during the baseline survey.

3.3.2 Percent tree and shrub cover

H. vernicosus does not tolerate shading from woody species, so both tree cover and shrub cover were monitored in each stop at each site. All sites passed on both attributes, with Hv07 Scragh Bog having the highest tree cover with an average of 11.8% across the monitoring stops recorded. Shrub cover was highest in Hv02 Rathavisteen where c. 15% cover was recorded. This comprised *Calluna vulgaris* (10%), *Myrica gale* (7%) and *Salix aurita* (1%).

Table 11 Results of the Habitat for the Species assessment for the 11 *Hamatocaulis vernicosus* sites surveyed in 2015–2017; Favourable (Fav) = 7–8 attributes passed; Unfavourable-Inadequate (Unfav-In) = 5–6 attributes passed; Unfavourable-Bad = 0–4 attributes passed.

Site code	Hv01	Hv02	Hv03	Hv04	Hv05	Hv06	Hv07	Hv08a	Hv08b	Hv08c	Hv09
Area (m^2)	Pass	Pass*	Pass	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Pass
Hydrology	Pass	Pass	Pass	Pass	Pass*	Pass	Pass	Pass	Pass	Pass	Pass
Mean % tree cover	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Mean % shrub cover	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Mean % grass cover	Pass	Pass	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Fail	Pass
Mean % bryophyte cover	Fail	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass
Mean % *Calliergonella cuspidata* cover	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass
Mean vegetation height (cm)	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
No. of passes	7	7	8	8	7	7	8	8	8	5	8
Habitat for the Species assessment	Fav	Fav	Fav	Fav	Fav	Fav	Fav	Fav	Fav	Unfav-In	Fav

* Deemed to pass on expert judgement

3.3.3 Percent grass cover

All sites passed for this attribute except Hv05 Owenbrin (54% grass cover recorded across the monitoring stops) and Hv08c Coumtay, with 27.5%.

3.3.4 Percent bryophyte cover

All sites passed for this attribute apart from Hv02 Rathavisteen (25% bryophyte cover) and Hv08c Coumtay (40% bryophyte cover).

3.3.5 Cover of *Calliergonella cuspidate*

All sites passed the target of <15% cover of *Calliergonella cuspidata* except Hv08c Coumtay, where 28% cover of *C. cuspidata* was recorded. From analysis of surface water samples, this may be the result of eutrophication at the site.

3.3.6 Mean vegetation height

All sites passed the mean vegetation height attribute targets set.

3.4 Pressures, threats and other activities

Prior to evaluating the Future prospects parameter, the activities, both positive and negative, recorded during the 2015–2017 survey at all *Hamatocaulis vernicosus* localities were examined. These are shown in Table 12, with pressures and threats recorded as having a negative influence, and other impacting activities having a neutral or positive influence. The table also includes the intensity level of the impacting activities (high, medium or low) and the percentage of the extent of occurrence affected by the activities.

Table 12 List of impacts, by influence, percentage of the extent of occurrence affected (% affected) and intensity in the habitat for *Hamatocaulis vernicosus* recorded at each site during the 2015–2017 survey.

Site code and name	Impact code	Impact description	Influence	% affected	Intensity
Hv01 Meentygrannagh	A04.02.02	Non-intensive sheep grazing	Positive	100	Low
	J02.07.01	Groundwater abstractions	Negative	1-25	High
	K04.05	Damage by herbivores (including game species)	Positive	76-99	Low
Hv02 Rathavisteen	A04.02.02	Non-intensive sheep grazing	Positive	100	Low
Hv03 Largan More	A04.02.01	Non-intensive cattle grazing	Negative	100	Low
	A04.02.02	Non-intensive sheep grazing	Positive	100	Medium
	G05.01	Trampling, overuse	Negative	1-25	Low
Hv04 Uggool	A04.02.02	Non-intensive sheep grazing	Positive	76-99	Medium
	K01.01	Erosion	Negative	1-25	High
Hv05 Owenbrin	A04.02.02	Non-intensive sheep grazing	Positive	100	Medium
	A03.02	Non-intensive mowing	Positive	76-99	Low
	G01.03.01	Regular motorized driving	Neutral	1-25	Low
Hv06 NW of Gortachalla Lough	G01.03	Motorised vehicles	Neutral	1-25	High
	J02.07.01	Groundwater abstractions	Negative	1-25	High
Hv07 Scragh Bog	X	No pressures or apparent threats			
Hv08a Below Sgilloge Loughs	A04.02.02	Non-intensive sheep grazing	Positive	100	Medium
Hv08b Nier River Valley	A04.02.02	Non-intensive sheep grazing	Positive	100	Medium
Hv08c Coumtay	A04.02.02	Non-intensive sheep grazing	Negative	100	High
Hv09 Commas	A04.02.02	Non-intensive sheep grazing	Positive	100	Medium

Grazing at a non-intensive level was the main activity noted, with sheep being the most frequent type of grazer. Deer grazing was also recorded at Hv01 Meentygrannagh. Grazing, at appropriate levels, is recorded as having a positive influence as it prevents both vegetation becoming rank and scrub encroachment. Cattle grazing was noted at Hv03 Largan More as a negative influence as it was causing some localised poaching in a small area.

Sheep grazing at Hv08c Coumtay is deemed to be a negative impact as, although the flush did not appear to be overgrazed itself (although the intensity of grazing recorded was higher than at the two other sites in the Comeragh Mountains SAC, where grazing of medium intensity was recorded), the surrounding slopes were heavily overgrazed and eutrophication may be the reason for the failure of the Habitat for the Species assessment at that site.

Erosion was recorded as a high-intensity negative impact at Hv04 Uggool, affecting 1–25% of the extent of occurrence.

A negative impact recorded with a high intensity affecting 1–25% of both Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough was groundwater abstractions. At Hv01 Meentygrannagh, formerly vegetated drainage ditches had been excavated within the extent of occurrence since the last site visit during the baseline survey in 2011. At Hv06 NW of Gortachalla Lough, a drainage ditch along a wall just outside the extent of occurrence had been excavated since 2011.

Climate change was not recorded as an impact during the 2015–2017 survey, but it may affect the altitudinal and latitudinal range of *Hamatocaulis vernicosus* in Ireland in decades to come if average temperatures continue to rise, particularly as the habitat for the species may be altered by drought.

3.5 Future prospects assessment

Table 13 shows the Future prospects assessment for the 11 *Hamatocaulis vernicosus* sites surveyed in 2015–2017 when the effects of negative impacts and positive activities were weighed up against each other in the context of each site's Population assessment and Habitat for the Species assessment. Future prospects were assessed over the next 12 years (two reporting periods).

Table 13 Future prospects (FP) assessment for the 11 Hamatocaulis vernicosus sites surveyed during the 2015–2017 survey taking into consideration Future prospects of the Population (Pop.) and of Habitat for the Species (Habitat); Fav = Favourable, Unfav-In = Unfavourable-Inadequate.

Site code	Site name	FP of Pop.	FP of Habitat	FP of site	Rationale
Hv01	Meentygrannagh	Fav	Fav	Fav	Negative effect of drainage affecting 1-25% of extent. Good prospects for recovery. Grazed appropriately.
Hv02	Rathavisteen	Fav	Fav	Fav	Small population but naturally so. Suitable grazing regime.
Hv03	Largan More	Fav	Fav	Fav	Negative pressure of poaching from cattle affecting small proportion of habitat outweighed by positive impact of sheep grazing overall.
Hv04	Uggool	Fav	Fav	Fav	Negative pressure of erosion affecting small proportion of habitat outweighed by positive impact of grazing.
Hv05	Owenbrin	Fav	Fav	Fav	Suitable grazing and mowing regime.
Hv06	NW of Gortachalla Lough	Fav	Fav	Fav	Negative effect of drainage affecting 1-25% of extent. Good prospects for recovery.
Hv07	Scragh Bog	Fav	Fav	Fav	No pressures.
Hv08a	Below Sgilloge Loughs	Fav	Fav	Fav	Suitable grazing regime.
Hv08b	Nier River Valley	Fav	Fav	Fav	Suitable grazing regime.
Hv08c	Coumtay	Fav	Unfav-In	Unfav-In	Evidence of eutrophication, probably due to overgrazing.
Hv09	Commas	Fav	Fav	Fav	Suitable grazing regime.

The Future prospects at Hv08c Coumtay are assessed as Unfavourable-Inadequate. When recorded in 2007 (Hodgetts, 2007) only a small population ('several dozen shoots over an area of c. 1m²'; see also Campbell *et al*., 2015) occurred. This is a very small population, with an extent of occurrence of 64m² with low cover (4%) of *H. vernicosus* recorded during the 2015–2017 survey, to give an area covered by the population estimate of 2.6m². The site may only ever have contained a small population in a marginal example of suitable habitat and it has persisted since 2007 when it was noted that the site was

overgrazed (Hodgetts, 2007). For this reason, Population at Hv08c Coumtay is assessed as having favourable Future prospects. However, if levels of grazing are not reduced, the quality of the Habitat for the Species may not improve and thus Future prospects are deemed to be Unfavourable-Inadequate.

3.6 Overall conservation assessment

3.6.1 Overall conservation assessment at the site level

The assessments of the individual parameters at each site were combined according to the evaluation matrix in Table 1 to obtain the overall conservation assessment for *Hamatocaulis vernicosus* at each site. This resulted in eight sites receiving a Favourable assessment across the three parameters and three received an Unfavourable-Inadequate assessment (see Table 14).

Table 14 Results of the overall conservation assessment at the site level when all three parameters were assessed during the 2015–2017 survey; Fav = Favourable; Unfav-In = Unfavourable-Inadequate.

Site code	Site name	Population	Habitat for the Species	Future prospects	Overall
Hv01	Meentygrannagh	Unfav – In	Fav	Fav	Unfav – In
Hv02	Rathavisteen	Fav	Fav	Fav	Fav
Hv03	Largan More	Fav	Fav	Fav	Fav
Hv04	Uggool	Fav	Fav	Fav	Fav
Hv05	Owenbrin	Fav	Fav	Fav	Fav
Hv06	NW of Gortachalla Lough	Unfav – In	Fav	Fav	Unfav – In
Hv07	Scragh Bog	Fav	Fav	Fav	Fav
Hv08a	Below Sgilloge Loughs	Fav	Fav	Fav	Fav
Hv08b	Nier River Valley	Fav	Fav	Fav	Fav
Hv08c	Coumtay	Fav	Unfav – In	Unfav – In	Unfav – In
Hv09	Commas	Fav	Fav	Fav	Fav

3.6.2 National assessment of parameters

Following EU guidance (DG Environment, 2017), the following national assessment was made for the Population and Habitat for the Species.

Population:

- The short-term (i.e. over the next 12 years) future trend for the population of *H. vernicosus* is assessed as *stable* as future threats and positive activities likely to occur are expected to be in balance overall.
- The current conservation status of the Population parameter has been assessed as *Favourable*.
- The Future prospects of the Population parameter are therefore assessed as *good*.

Habitat for the Species:

- The short-term future trend for the Habitat for the Species for *H. vernicosus* is assessed as *stable* as drainage and other negative impacts are not currently impacting significantly on the habitat, with the balance of

positive activities, such as appropriate grazing levels, generally balancing out negative impacts, such as poaching/erosion.

- The current conservation status of the Habitat for the species parameter has been assessed as *Favourable* as >99% of habitat is in "good" condition with Future prospects good at 10 of the 11 sites (>90%) for this parameter.
- The Future prospects of the Habitat for the species parameter are therefore assessed as *good*.

Recommendations are given at the end of the report for a number of measures that should maintain the future trend of the Population and Habitat for the Species parameters at *stable*. It should be recognised that the management regimes of most *H. vernicosus* sites are currently driven by the landowner rather than by any formal management plan or policy; therefore, the continued operation of the management regimes currently in place, which have contributed to the favourable result for Habitat for the Species, is assumed, but not guaranteed.

3.6.3 Overall national conservation assessment

The assessments of the individual parameters were combined according to the evaluation matrix in Table 1 to obtain the overall national conservation assessment for *Hamatocaulis vernicosus*.

Following the guidelines for habitat assessment at a national level (DG Environment, 2017) and based on the results presented here, the estimated future trends of the Population and Habitat for the Species parameters based on the pressures and threats operating on the Population and Habitat for the Species and positive management and conservation measures in place, the national Overall Conservation Assessment result for *Hamatocaulis vernicosus* is **Favourable** and the trend is ***stable***. The following data detailed in this report were used to arrive at this result:

- the Population assessments at Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough were assessed as Unfavourable-Inadequate due to a recorded decrease in overall percentage cover and density of *H. vernicosus*. This is linked to drainage activities affecting 1–25% of extent of occurrence at these sites and, if no further drainage activities occur, the prospects of recovery are good as the ditches revegetate naturally. The Population assessment at a national level is assessed as Favourable;
- the Habitat for the Species assessment at Hv08c Coumtay received an Unfavourable-Inadequate rating. The population reported from this site when recorded in 2007 (Hodgetts, 2007) was always very small (covering less than 1m^2). The area covered by the population (m^2) at this site is 2.7m^2, which is <0.0001% of the national total. The Habitat for the Species assessment at a national level is assessed as Favourable;

the activities impacting the Population and Habitat for the Species are positive overall. The negative pressure of drainage at Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough is affecting 1–25% of the extent of occurrence at each site and there are good prospects of recovery once no further drainage activities take place. The effects of positive impacts currently outweigh any negative impacts and overall Future prospects are deemed to be good. Table 15 summarises this result.

Table 15 Summary of the national conservation assessment of *Hamatocaulis vernicosus*, based on the results of the 2015–2017 survey.

Parameter	Conservation Status	Trend	Future Prospects
Population	Favourable	Stable	Good
Habitat for the Species	Favourable	Stable	Good
OVERALL NATIONAL CONSERVATION ASSESSMENT	***Favourable***	***Stable***	

It should be noted that the current survey did not include an assessment of the Range parameter, but the Range is the same as the 2007–2012 reporting period as no populations have been lost and no population has extended into an additional 10km x 10km grid square. This is the Favourable Reference Range and so the Range parameter is also Favourable with a Stable trend.

3.7 *Hamatocaulis vernicosus* inside and outside of the SAC network

In Ireland, any population of an Annex II species that lies outside an SAC, or that occurs within an SAC but is not listed as a Qualifying Interest (QI) for that SAC, does not have the same level of legal protection as a population that occurs within an SAC for which the species is listed as a QI.

The extent of occurrence polygons at all 11 *H. vernicosus* sites are situated inside an SAC and the species is listed as a QI in each of the SACs within which they occur (see Table 2).

4 Discussion

4.1 Conservation assessment of *Hamatocaulis vernicosus*

4.1.1 Overall national conservation status of *Hamatocaulis vernicosus*

Based on the results of the 2015–2017 survey, the overall national conservation status of *Hamatocaulis vernicosus* is assessed as Favourable as Population, Habitat for the Species and Future prospects are all assessed as Favourable. While there was no change in the overall national conservation status assessment of *H. vernicosus* between this monitoring period and the last, there were changes in the status in some of the individual site assessments, most notably Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough, which are assessed as Unfavourable-Inadequate in this reporting period. Hv08c Coumtay was fully surveyed during the 2015–2017 survey and eutrophication from overgrazing is thought to be the reason for the failure of the Habitat for the Species assessment at this site. The results of the 2015–2017 survey highlight activities negatively impacting on Population and the Habitat for the Species at a local level that need to be closely monitored in future reporting rounds.

4.1.2 Population

The Population parameter was assessed using three attributes, with a minimum of two needing to pass to achieve a Favourable assessment. All sites passed the extent of occurrence attribute. The extent of occurrence increased at some sites, e.g. Hv01 Meentygrannagh, due to additional colonies being found which enlarged the area within which *H. vernicosus* occurs. *H. vernicosus* is relatively small and can only be observed within microhabitats when relatively close to them. Therefore, it can be easily overlooked, particularly when occurring as scattered stems within a large site. In all cases, the discovery of new colonies during the 2015–2017 survey is thought to be due to increased search effort and not a genuine expansion of the population at these sites. In other cases, changes to the area of extent of occurrence resulted from more accurate mapping of the extent of occurrence polygons, for example, at Hv03 Largan More and Hv08a Below Sgilloge Loughs where the flushes within which the species occurs were more closely mapped. Thus, although the overall area of the extent of occurrence at these two sites did not meet targets set by Campbell *et al*. (2015), these sites were allowed to pass this attribute using expert judgement.

Targets set for mean percent cover of *H. vernicosus* were allowed pass on expert judgement where there was a marginal fail and where no anthropogenic cause could be implicated, i.e. at Hv07 Scragh Bog (marginal fail of 1%) and Hv08b Nier River Valley (marginal fail of 5%), where the Habitat for the Species assessment passed at both sites also. However, at Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough, the overall failure of this attribute and of the shoot density attribute could be linked to drainage activities in part of the sites. Drainage ditches had been deepened and widened in parts of both sites which appeared to be affecting 1–25% of the extent of occurrence at both sites. It is thought that if no further drainage activity takes place at these sites, the drains should become revegetated naturally over time and the population in the areas affected should recover once hydrological conditions are restored. Mechanical refilling of the drains at these sites, particularly at Hv01 Meentygrannagh, is not recommended as it would cause more damage to the habitat. Blocking or refilling of the drains in a sensitive manner, i.e. manually, may accelerate the rate of recovery.

The population at Hv05 Owenbrin failed the density attribute target, although cover of *H. vernicosus* exceeded the target set. While passing the assessment for this reporting period, the population at Hv05 Owenbrin should be closely monitored in the next reporting round for reasons discussed in Section 4.1.3.

Overall, Future prospects for the long-term survival of the species in the 11 sites are good. Some populations are naturally small, e.g. at Hv02 Rathavisteen, while others cover relatively large areas, particularly at Hv07 Scragh Bog. Sporophytes were not observed during the 2015–2017 survey at any of the sites, despite the survey being carried out at the time of year when sporophytes have been observed in locations where they are known to occur in Europe. Campbell (2013) found evidence to suggest that gametangia are produced at Irish sites in summer and found that the percentage of male and female shoots varied within and among the sites, e.g. some plots in Hv01 Meentygrannagh, Hv03 Largan More, Hv06 NW of Gortachalla Lough and Hv08a below Sgilloge Loughs had both male and female shoots present. Some spatially separated plots within these sites had only males or only females (Campbell, 2013), which would impede sexual reproduction and production of sporophytes, even if conditions were suitable (Pépin *et al*., 2013). Only male shoots were found at Hv04 Uggool and Hv09 Commas during the 2015–2017 survey. Only male stems were recorded in Hv05 Owenbrin, and only females in Hv08b Nier River Valley and Hv07 Scragh Bog by Campbell (2013). This would prevent sexual reproduction from taking place at these sites. While this information is not used in the Population assessment, it is useful to obtain data on the population structure at the sites. Despite propagation of the species presumably occurring through vegetative means, Campbell (2013) found genetic variation within seven of the largest populations studied. However, the majority of genetic variation found was among the populations as opposed to within them and is was found that gene flow among the geographically fragmented populations is minimal (Campbell, 2013). Therefore, conservation of all 11 populations is essential.

For the 2013–2018 reporting period, the population size unit that must be reported on is number of 1km x 1km grid squares. The 11 populations of *H. vernicosus* fall within nineteen 1km x 1km Irish National grid squares and this can be used for comparison in future reporting periods.

4.1.3 Habitat for the species

Habitat for the Species in Favourable condition is determined by having sufficient area and quality to allow the long-term survival of the species. The attributes assessed are those deemed to be of high importance to the maintenance of suitable conditions for the species, i.e. suitable hydrology, no encroachment by trees or shrubs, no rank grass cover, no increased nutrient input leading to increased (grass and) *Calliergonella cuspidata* cover, open conditions with a relatively high bryophyte cover and a relatively low vegetation height to prevent shading and indicate suitable grazing regimes. On this basis, the majority of the Habitat for the Species assessments were Favourable, with the area in good condition overall, estimated by adding up the area of sites that received a Favourable result for their Habitat for the Species assessment. A total of >99% of the area of the Habitat for the Species was deemed to be in good (Favourable) condition.

Hv08c Coumtay was the only site to receive an Unfavourable-Inadequate assessment for the Habitat for the Species parameter as it failed on three of the eight attributes assessed, grass cover (marginal fail of 2.5%), bryophyte cover and cover of *C. cuspidata*. *C. cuspidata* has been reported as becoming dominant when nutrient levels are elevated (Kooijman, 1993; Hedenäs, 2003). This site occurs in a flush in the uplands that did not appear to be overgrazed itself, although the flush is more heavily grazed by sheep than the other two sites in the Comeragh Mountains SAC, Hv08a Below Sgilloge Loughs and Hv08b Nier River Valley. However, the surrounding slopes are heavily overgrazed and the results of the Habitat for the Species assessment and the water sample analysis suggest that the site is eutrophicated. When recorded in 2007 (Hodgetts, 2007), there was only a small population reported ('several dozen shoots over an area of c. 1m^{2}'; see also Campbell *et al*., 2015). This is a very small population with an area covered by the population estimate from the 2015–2017 survey of 2.6m^{2}. The population may always have been small as a result of the site containing only marginally suitable habitat for the species. For this reason, Population is assessed as Favourable and as the species has persisted at the site since 2007 when the site was also noted as being overgrazed, Future prospects for Population are deemed to be good. However, the Future prospects of the Habitat for the Species are not good if stocking levels are not reduced.

The bryophyte cover target of more than 50% cover failed by 2% at Hv01 Meentygrannagh, where a mean bryophyte cover of 48% was recorded. This again could be linked to drainage activities that are also deemed to be implicated in the Population assessment receiving an Unfavourable-Inadequate status result. While slightly drier than at other monitoring stops, the surface water level was still just at the surface of the root mat in the two monitoring stops close to the ditches and all other attributes passed, and providing no further drainage activities occur at this site the Future prospects for Habitat for the Species at this site are good.

Hv06 NW of Gortachalla Lough failed the area covered by the population (area of suitable habitat) attribute as was this calculated using the mean percentage cover of *H. vernicosus* averaged across the site. However, this could be linked to the excavation of a ditch along a wall in the north-east of the site, just outside the extent of occurrence. Only part of the extent of occurrence within the site (1–25%) appears to be affected by drainage; all monitoring stops were wet, with a mean surface water depth of 4cm, and one of the monitoring plots in the north of the extent of occurrence had a higher cover of *H. vernicosus* than recorded during the baseline survey. Previously unrecorded colonies were also found in this area during the 2015–2017 survey. The attributes assessing the habitat quality indicators all passed at this site. The site still holds a large population of *H. vernicosus* and the area affected by drainage should recover in time once no further drainage activity takes place and the ditch along the wall revegetates naturally. Again, similar to the situation at Hv01 Meentygrannagh, the ditch could be blocked or refilled manually to decrease any further damage to the site and this may accelerate the recovery of the areas affected.

Campbell (2013) studied the water levels at seven of the largest *H. vernicosus* localities and it was discovered that *H. vernicosus* can withstand larger fluctuations in water table level than previously thought, particularly in the lowland sites where the most extensive populations of *H. vernicosus* occur and where the water level can drop considerably below the surface level of the root mat vegetation, particularly at Hv05 Owenbrin on the Lough Mask floodplain. When surveyed during the 2015–2017 survey, the water table at Hv05 Owenbrin was far below the ground surface (from 55cm to over 70cm). The attribute for hydrology was allowed to pass as this is not uncommon at this site, which lies in the floodplain of Lough Mask and is reliant on lake levels. However, Lough Mask has been downgraded from high ecological status to good ecological status by the EPA (Fanning *et al*., 2017) due to negative changes in hydromorphology, so the hydrological condition at Hv05 Owenbrin should be closely monitored in the next reporting period. Studies have shown *H. vernicosus* to have a higher level of desiccation tolerance than would be expected for a fen/mire species (Manukjanová *et al*., 2014) and the species has also been found to be tolerant to submergence over longer periods compared with other species (Borkenhagen & Cooper, 2018). Measurements of water table levels at all sites over a longer monitoring time-period (>12 years) will further elucidate temporal fluctuations (McBride *et al*., 2011).

The grass cover attribute failed at Hv05 Owenbrin, exceeding the target of less than 25% by almost 30%, with a mean grass cover of 54% recorded during the 2015–2017 survey. Increased nutrients and/or undergrazing can change the vegetation composition; tall-herbs and grasses can begin to dominate at the expense of brown mosses (McBride *et al*., 2011). The site is grazed appropriately and is regularly mown, and it is not clear why grass cover has increased. There was still an adequate mean cover of bryophytes (65%) and very low mean cover of *Calliergonella cuspidata* (1%). However, it is possible that increased nutrients may have come from the lake water inundating the site from Lough Mask, or floodwaters from the Owenbrin River. This would need to be closely monitored in the next reporting period, with surface water samples being taken for nutrient analysis at this site if necessary.

The largest population of *H. vernicosus* occurs at Hv07 Scragh Bog and no change from the baseline survey was noted at this site. This site is not grazed and so the target for mean vegetation height is higher than for other sites; however, the species is thriving here, even in the absence of grazing and no management recommendations are put forward, apart from maintaining the current conditions. In particular, the hydrological regime must be maintained. The site is surrounded by agricultural land which slopes toward the depression within which the sites lies. The target for *Calliergonella cuspidata*, an indicator of increased nutrient input, is again higher at this site than for others, but *C. cuspidata* is a

frequent associate of *H. vernicosus* at all sites, and the higher levels recorded of *C. cuspidata* recorded during the baseline survey are not deemed to be negative. There is a natural buffer zone around the fen (Beltman *et al*., 2002) and Future prospects of both Population and Habitat for the Species are deemed to be good, but frequent monitoring is still recommended. Hv07 Scragh Bog had the highest tree cover recorded at the sites during the 2015–2017 survey, with an average of 11.8% across the monitoring plots recorded. Again, this should be monitored as the site is not grazed and natural succession from transition mire to raised bog can cause drying out and make conditions more suitable for tree and shrub growth and any drainage may accelerate this.

4.1.4 Impacts/Activities and Future prospects

The impacting activity recorded most frequently across the sites was grazing, usually affecting large areas of the extent of occurrence where recorded. Sheep grazing was most common, but cattle grazing was recorded as occurring at Hv03 Largan More. Deer grazing also occurs at Hv01 Meentygrannagh. Grazing was deemed as non-intensive and beneficial to the Habitat for the Species as it maintains a low vegetation sward and prevents unwanted rank grass and scrub encroachment which would out-compete and shade out *H. vernicosus*. A low level of trampling by grazing animals can also be beneficial as it maintains open conditions, and it was observed on repeat site visits during the baseline survey (Campbell, 2013) that *H. vernicosus* can even colonise previously trampled microhabitats. However, the negative effects of poaching, erosion and eutrophication have to be outweighed by the positive effects for the grazing regime to be beneficial. Poaching/trampling was recorded in a small proportion (1–25%) of the extent of occurrence at Hv03 Largan More where cattle grazing takes place. It is considered that cattle grazing is not appropriate for flushes and fen/mires as they are too heavy for the fragile habitat and can cause excessive poaching and erosion. As such, cattle grazing is not recommended at Hv03 Largan More. Erosion was also recorded at Hv04 Uggool which is grazed by sheep. The erosion affected 1–25% of the extent of occurrence and could have been caused naturally through exposure of this upland site, or from excessive rainfall, or could be due to past overgrazing at the site. The surface water taken from a monitoring stop recorded in the area affected by erosion had high total phosphate and ortho-phosphate levels. Grass cover (10%) and cover of *Calliergonella cuspidata* (10%) was higher than recorded in the other monitoring stops. These are below the targets set for these attributes, but these results and the results from the surface water analysis indicate some eutrophication in this area. The beneficial effects of grazing currently outweigh the negative impacts at this site, but this needs to be closely monitored in the next reporting period.

At Hv08c Coumtay, the results of the Habitat for the Species assessment and water sample analysis suggest that there may be an issue of eutrophication from overgrazing of the slopes surrounding the flush.

Another serious high impacting negative activity recorded during the 2015–2017 survey was drainage at Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough where drainage ditches had been excavated since the baseline survey (last site visits were in 2011; Campbell, 2013), although only 1–25% of the area of the extent of occurrence was affected at each site. Drainage had previously taken place in the fen area at Hv01 Meentygrannagh *circa* 1998, but, through the intervention of NPWS, the drains had been blocked at that time. As the area of the extent of occurrence thought to be affected by this damaging activity is 1–25%, and the activity should not be allowed to re-occur, and as the ditches should revegetate naturally, the Future prospects of the Population and Habitat for the Species are favourable overall.

Climate change does not appear to be currently impacting on the species, but it is likely to affect the altitudinal and latitudinal range of *H. vernicosus* in Ireland in decades to come if average temperatures continue to rise. Any long-term changes to hydrology due to prolonged drought would be unfavourable for *H. vernicosus* habitat.

5 Recommendations

5.1 Management recommendations

The management recommendation for most sites is to maintain the current grazing regime. Undergrazing can result in succession which would lead to more closed vegetation conditions causing *H. vernicosus* being out-competed and shaded out. An increase in stocking levels at any of the sites could lead to changes in the vegetation structure and physical damage, such as poaching and erosion. It is recommended that cattle grazing be removed from the fragile flushes at Hv03 Largan More as it is causing some localised poaching. Overstocking can also lead to eutrophication which can favour more vigorous species, including grasses, at the expense of less competitive and less nutrient-demanding species such as *H. vernicosus*. In the case of bryophytes, *Calliergonella cuspidata* is the most common beneficiary of increased nutrient input in wet grassland and fens, particularly in conditions that are neither strongly acidic nor strongly basic (Hedenäs, 2003). Overgrazing by sheep appears to be the reason behind the eutrophication at Hv08c Coumtay which was shown through water sample analysis and in the Habitat for the Species assessment results. It is recommended that stocking levels be reduced at this site.

The 11 populations of *H. vernicosus* are contained within nine SACs and listed as a Qualifying Interest (QI) for each SAC. The EU habitats Transition mires and quaking bogs (EU Habitat code 7140) and Alkaline fens (7230) are QIs for Meentygrannagh Bog SAC. NPWS provide a list of Activities Requiring Consent (ARCs) that are only granted if they do not negatively impact on any QIs within an SAC. Habitat and species that are listed as a QI in SACs are protected by the Habitat Regulations (S.I. No. 477 of 2011), which regulate any plans or projects that might negatively impact on *H. vernicosus* populations. It is recommended that further drainage activities at Hv01 Meentygrannagh and Hv06 NW of Gortachalla Lough be prevented, as well as any other damaging activities at these sites and all *H. vernicosus* sites.

It should be recognised that the management regimes of most habitats in *H. vernicosus* sites are driven by the landowner rather than by any formal management plan or policy; therefore, the continued operation of the management regimes currently in place is not guaranteed, for e.g. mowing at Hv05 Owenbrin. Management plans for the SACs within which *H. vernicosus* occurs should be drawn up.

5.2 Refinements to future assessment methodology

The extent of occurrence was expanded at some sites where new colonies were found. This is not surprising as *H. vernicosus* can be easily overlooked due to the species' small size and, as it can easily be confused with other similar species, such as *Warnstorfia exannulata*, *Scorpidium cossonii* and *S. revolvens*, specimens have to be verified using a hand lens, which is time consuming. It is not unreasonable to assume that in future monitoring surveys more colonies will be discovered, thus changing the area of the extent of occurrence. As this figure is multiplied by the mean percentage cover of *H. vernicosus* to obtain the figure for area covered by the population, the latter figure can be affected thus making comparisons between surveys difficult. Also, the percentage cover of *H. vernicosus* in an area can vary quite considerably within sites and so comparisons between monitoring periods are heavily dependent on the exact replication of monitoring stops which is not always feasible. One solution could be to permanently mark the plots with, for example, wooden/metal stakes demarcating two diagonal corners of the plot. Another solution could be to record more monitoring plots in the sites to obtain a better picture of the variation in cover, particularly when the extent of occurrence is expanded.

While shoot density gives an indication of the vigour of the population and is recommended to still be recorded in future monitoring surveys for information purposes, it may not be necessary to set targets for this attribute to be used in the Population assessment. The shoot density result is quite dependent

on whereabouts within the monitoring plot the 10cm x 10cm count is taken and, while counts were taken within 10cm x 10cm areas deemed representative of the plot, density within plots can vary quite significantly. The EU guidelines for the last two Article 17 reporting periods have specified population size units in terms of area, and thus the number of shoots is not reported on. Density of shoots is not recommended as a population size unit as it does not represent the number of genetically distinct individuals. Therefore, setting targets associated with area alone may suffice.

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Appendix 1 Site summary data sheet

This data sheet was used as a front sheet for all site packs. Some information, such as the site number, name and grid reference, was printed on the sheet prior to survey.

The Survey details and Survey notes sections, including positive and negative activities occurring on site, were filled out by surveyors after the survey had been completed.

bec CONSULTANTS

Rare Plants Monitoring Survey 2015–18
Hamatocaulis vernicosus

Survey details:

Date surveyed: _____ ***Surveyed by:*** _____

Extent of occurrence mapped _____

Time spent on site: _____ ***Voucher taken:*** _____

Site no:	[Auto-filled before survey]	**Disco. map:**	[Auto-filled before survey]
Site name:	[Auto-filled before survey]	**Aerial photo no. (2005):**	[Auto-filled before survey]
Grid ref:	[Auto-filled before survey]	**Vice county number:**	[Auto-filled before survey]
SAC:	[Auto-filled before survey]	**Type of survey:**	[FULL/MONITORING]

Survey notes:

Site description or changes since baseline:

Impact code / description e.g. A04.01 intensive grazing	**Location** inside / outside extent of occurrence	**Influence (+/-/0)**	**Intensity (H/M/L)**	**% extent of occurrence affected** (<1%; 1-25%; 26-50%; 51-75%; 76-99%; 100%)

Comments on condition/management:

Other remarks:

Data entry/checking:

GPS points downloaded: INITIALS _____ DATE _____
Turboveg checked: INITIALS _____ DATE _____
Photos labelled correctly: INITIALS _____ DATE _____
Data checked & complete: INITIALS _____ DATE _____

Appendix 2 Turboveg header data recorded at each monitoring stop

At all sites, the following header information was recorded at the monitoring stops in the vegetation database recording program Turboveg (Compact Edition for use on hand-held devices; Alterra, The Netherlands):

1. COVER SCALE: Percentage (%) was always selected.
2. DATE: Date monitoring stop was recorded.
3. SITE_NO: Site number, e.g. Hv01, Hv02, etc.
4. SITE_NAME: Site name, e.g. Meentygrannagh, Rathavisteen, etc.
5. PLOT_ID: Monitoring stop number, e.g. Hv01_01, Hv01_02, etc.
6. PLOT_AREA: Always 2m x 2m.
7. SURVEYORS: Name of ecologist(s) recording the monitoring stop.
8. GRID_REF: Grid reference of monitoring stop in Irish National Grid.
9. ELEVATION: In metres above sea level.
10. EXTENT_MAPPED: Yes/No; extent should be mapped before recording monitoring stops.
11. ASPECT: Cardinal or ordinal compass point (N, NW, etc.) of stop's aspect if on a slope, otherwise "None".
12. SLOPE: Slope in degrees, determined by clinometer, if on a slope, otherwise 0.
13. PHOTO_ID: Identification of photos taken.
14. WATR_DPTH1: Depth of surface water measurement 1 of 5 in stop.
15. WATR_DPTH2: Depth of surface water measurement 2 of 5 in stop.
16. WATR_DPTH3: Depth of surface water measurement 3 of 5 in stop.
17. WATR_DPTH4: Depth of surface water measurement 4 of 5 in stop.
18. WATR_DPTH5: Depth of surface water measurement 5 of 5 in stop.
19. HAND_COVD: Yes/No whether hand is covered by water when pressed into the vegetation in the stop.
20. HAM_V_CO1: Cover of *Hamatocaulis vernicosus* in the stop.
21. NO_SHOOTS: Number of shoots of *Hamatocaulis vernicosus* in a 10cm x 10cm area in the stop.
22. TREE_COV: Percent cover of trees in the stop.
23. SHRUB_COV: Percent cover of shrubs in the stop.
24. GRASS_COV: Percent cover of grasses in stop.
25. BRYO_COV: Percent cover of bryophytes in the stop.
26. CCUSP_COV: Percent cover of *Calliergonella cuspidata* in the stop.
27. MEAN_VEGHT: Mean height of vegetation in the stop measured with a ruler/measuring tape.
28. SHOOT_TAKEN: Yes/No whether sample of 100+ shoots (if available) taken for gametophyte analysis from the stop in full survey sites.
29. PEAT_DEP: Depth of peat (cm) in the stop in full survey sites.
30. MAX_VEG_H: Maximum height of vegetation in the stop in full survey sites.
31. TOTAL_COVER: Total percent cover of vegetation in the stop in full survey sites.
32. RUSH_COV: Percent cover of rushes in the stop in full survey sites.
33. SEDGE_COV: Percent cover of sedges in the stop in full survey sites.
34. FORB_COV: Percent cover of forbs in the stop in full survey sites.
35. LICHEN_COV: Percent cover of lichens in the stop in full survey sites.
36. ALGAE_COV: Percent cover of algae in the stop in full survey sites.
37. LITTER: Percent cover of litter in the stop in full survey sites.
38. BARE_SOIL: Percent cover of bare soil in the stop in full survey sites.
39. BARE_ROCK: Percent cover of bare rock in the stop in full survey sites.
40. SURF_WATER: Percent cover of surface water in the stop in full survey sites.
41. DUNG_COVER: Percent cover of dung in the stop in full survey sites.
42. W_SAMPLE: Yes/No; A water sample should be taken from each stop in full survey sites for analysis
43. REMARKS: Free text field for recording additional information about the stop.

Appendix 3 Individual site reports

Individual site reports were compiled from the following:

- the summary paragraphs written by ecologists after each survey,
- the impacts recorded during the survey, and
- the results of the different components of the species assessment.

Site Hv01 Meentygrannagh, Co. Donegal
000173 Meentygranagh Bog SAC

Summary site data:

Location (Irish Grid):	206270 406070	**Discovery map:**	6, 11
Vice county:	West Donegal (H35) East Donegal (H34)	**Aerial photo no. (2005):**	O0302-D & O0324-B
Type of survey:	Monitoring	**No. of monitoring stops:**	5
Extent of occurrence (m²):	12,302	**Percent cover of *H. vernicosus*:**	7.7%
Area covered by the population (m²):	947	**Density (no. shoots/m²):** **Population estimation (shoots):**	6,000 c. 5,682,000

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	1	Unfavourable - Inadequate
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	Fail	
	Density (no. shoots/m²)	Fail	
Habitat for the Species:	No. of attributes passed	7	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Fail*	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			UNFAVOURABLE - INADEQUATE

*Marginal fail as bryophyte cover was 48%

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.02	Non-intensive sheep grazing	Positive	Low	100	
K04.05	Damage by herbivores (including game species)	Positive	Low	51-75	Deer grazing
J02.07.01	Groundwater abstractions for agriculture	Negative	High	1-25	Drainage ditches

Site description:

Hamatocaulis vernicosus occurs at this site in a lawn at the edge of a water track in a mesotrophic mire near a rocky knoll to the west of a forestry plantation, near the edge of the fen/mineral transition on the opposite side of the bog, north of the forestry plantation and in other areas of transition mire to the west of this area. The extent of occurrence was expanded from the baseline survey at this site in the area north of the forestry plantation, where formally unrecorded colonies were found. However, this may be the result of increased search effort and not a genuine expansion of the population.

In the area south of the main ditch, nearer the rocky knoll, old refilled drainage ditches that had been present during the baseline survey had been relatively freshly dug out. This was very evident particularly in the area close to the location of one of the monitoring stops, where cover of *H. vernicosus* had decreased. During the baseline survey, c. 25%

cover of *H. vernicosus* was recorded in the baseline plot, but only 3% was recorded in monitoring stop in 2016, during the 2015–2017 survey. While the precise position of the baseline plot would not necessarily be exactly replicated, the overall cover of *H. vernicosus* in the locality of the plot was low. The ditch close to another monitoring stop in this area had also been deepened. Conditions were also somewhat drier in these areas than in other parts of the site, although the surface water level was just at the surface of the root mat in the monitoring stops. The last site visit during the baseline survey was in February 2011 and the ditches had been deepened and widened since that time, although they were revegetating somewhat in 2016.

Drainage had previously taken place in the fen area in the SAC around 1998, but through the intervention of NPWS, the drains had been blocked. The newly excavated ditches may possibly be having an adverse effect on the hydrology for *H. vernicosus*, hence the lower cover of the species in the vicinity. If these drains are left to refill with vegetation naturally, or refilled/blocked in a sensitive manner, the population should recover. As long as no further drainage activities take place, the overall future prospects of the population are good.

Associated species recorded include *Juncus articulatus, Carex rostrata, C. panicea, C. echinata, Agrostis stolonifera, Holcus lanatus, Cardamine pratensis, Epilobium palustre, Menyanthes trifoliata, Ranunculus flammula, Calliergonella cuspidata, Pellia epiphylla* and *Warnstorfia exannulata*.

The rare boreal relict moss *Tomentypnum nitens* occurs in the site. This species is classified as *Vulnerable* in Ireland. The *Vulnerable* moss *Sphagnum warnstorfii* was recorded in one stop, the Near Threatened mosses *Rhizomnium pseudopunctatum* and *Sphagnum subsecundum* were recorded in one and two stops respectively, and the *Near Threatened* moss *Sphagnum teres* was recorded in a number of stops in the site.

Management recommendations:

The newly excavated ditches should be left to be revegetated naturally or refilled/blocked in a sensitive manner. Refilling using diggers is not recommended as this would impact negatively on the habitat for the species. Further drainage activities should not take place.

Site Hv02 Rathavisteen, Co. Mayo
000500 Glenamoy Bog Complex SAC

Summary site data:

Location (Irish Grid):	98117 37135	**Discovery map:**	23
Vice county:	West Mayo (H27)	**Aerial photo no. (2005):**	O0939-D
Type of survey:	Full survey	**No. of monitoring stops:**	1
Extent of occurrence (m²):	57	**Percent cover of *H. vernicosus*:**	0.3%
Area covered by the population (m²):	0.17	**Density (no. shoots/m²):**	900
		Population estimation (shoots):	c. 150

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	1	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	NA	
	Density (no. shoots/m²)	NA	
Habitat for the Species:	No. of attributes passed	7	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Fail	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected
A04.02.02	Non-intensive sheep grazing	Positive	Low	100

Site description:

Hamatocaulis vernicosus was discovered at this site by Dr Neil Lockhart of NPWS in June 1999, where a "small patch" (through an area of c. 10m x 1m) was found confined to the bases of *Carex paniculata* and other tussocky vegetation on the upper eastern margin of a poor fen/marsh area surrounded by blanket bog.

During the 2015–2017 survey, the site was first visited in August 2016 but, despite extensive searching, the species was not found. It was decided to re-visit the site the following autumn 2017 with Dr Lockhart who discovered the population there originally.

In 2017, Dr Lockhart described no change since his last visit. Only a very small number of *H. vernicosus* shoots were recorded in 2017 in two areas totaling 57m². The flush system is in a near natural state and in good condition. The substate was wet aqueous peat on a floating scraw. The paucity of *H. vernicosus* at this site is most likely due to the conditions being naturally marginally ideal for the species. There is not thought to have been any decrease in population size since 1999, when a very small amount of the species was found also. The results of the water chemistry anaylsis for pH, conductivity, ammonium, nitrate, ortho-phosphate and total phosphate were in line with results obtained during the baseline survey at the other sites. The habitat where the species was found was close to transition mire conditions. While no *Carex paniculata* was recorded in the 2017 monitoring stop, there were tussocks of the sedge in the general area

and many of the associated species recorded by Dr Lockhart were present in the stop, including *Carex limosa*, *C. echinata*, *Schoenus nigricans*, *Molinia caerulea*, *Ranunculus flammula*, *Myrica gale*, *Calliergonella cuspidata*, *Pseudoscleropodium purum*, *Spaghnum contortum* and *S. teres*.

The Habitat for the Species assessment failed on the bryophyte cover attribute, and the stop had more shrub cover than the relevé recorded by Dr Lockhart in 1999, but overall, the site was deemed to be in a near natural system. Grazing by sheep occurs at the site, but not at inappropriate levels for *H. vernicosus*.

The Flora (Protection) Order, 2015 listed *Hammarbya paludosa*, which is classifed as *Near Threatened* in Ireland, was found near the *H. verniosus* monitoring stop recorded and c. 25m away further south along the flush. The *Vulnerable* moss *Tomentynum nitens* is also present in the flush, indicating calcareous conditions. *Sphagnum subsecundum* and *S. teres*, recorded in the stop at the site, are both classified as *Near Threatened* in Ireland. The Vulnerable moss *Sphagnum flexusosum* forms extensive lawns in the wetter areas of the flush.

Management recommendations:

Maintain current grazing regime.

Site Hv03 Largan More, Co. Mayo
000476 Carrowmore Lake Complex SAC

Summary site data:

Location (Irish Grid):	90128 323927	**Discovery map:**	23
Vice county:	West Mayo (H27)	**Aerial photo no. (2005):**	O1239-A & O1239-B
Type of survey:	Monitoring	**No. of monitoring stops:**	4
Extent of occurrence (m²):	1,202	**Percent cover of *H. vernicosus*:**	32%
Area covered by the population (m²):	385	**Density (no. shoots/m²):**	12,900
		Population estimation (shoots):	c. 4,966,500

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	3	Favourable
	Extent of occurrence	Pass*	
	Mean % cover of *H. vernicosus*	Pass	
	Density (no. shoots/m²)	Pass	
Habitat for the Species:	No. of attributes passed	8	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

* Passed on expert judgement as marginal fail

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.02	Non- intensive sheep grazing	Positive	Medium	100	
A04.02.01	Non- intensive cattle grazing	Negative	Low	100	
G05.01	Trampling, overuse	Negative	Low	1-25	Poaching by cattle

Site description:

Hamatocaulis vernicosus is found in moss lawns and spring heads in a flush system surrounded by blanket bog at this site. The extent of occurrence was expanded from the baseline at this site where new colonies were recorded in another part of the flush system. However, this may be the result of increased search effort and not a genuine expansion of the population. Otherwise, there were no discernible changes to the site from the baseline survey. Overall, the figure for extent of occurrence was lower than the baseline, but this was due to more accurate mapping of the flushes and not a genuine decrease in area.

Associated species occurring with *H. vernicosus* included *Juncus bulbosus, J. acutiflorus, Agrostis stolonifera, Eriophorum angustifolium, Cardamine pratensis, Epilobium palustre, Potamogeton polygonifolius, Ranunculus flammula, Sagina nodosa, Philonotis fontana, Sphagnum denticulatum* and *Warnstorfia exannulata*.

Sheep were observed on the site and also cattle droppings, with some poaching in places, but overall, the levels of grazing are not damaging. However, cattle grazing is not recommended in fragile flushes as they are too heavy, and it is recommended that any cattle grazing ceases at this site.

This is also a site for the Annex II and Flora (Protection) Order, 2015 listed, and *Near Threatened*, *Saxifraga hirculus* and the plant was recorded in one of the monitoring stops. The *Near Threatened* moss *Rhizomnium pseudopunctatum* was also recorded in one stop.

Management recommendations:

Maintain current sheep grazing regime. Remove cattle grazing from the site.

Site Hv04 Uggool, Co. Mayo
000534 Owenduff/Nephin Complex SAC

Summary site data:

Location (Irish Grid):	92533 318750	**Discovery map:**	23
Vice county:	West Mayo (H27)	**Aerial photo no. (2005):**	O1378-A
Type of survey:	Baseline	**No. of monitoring stops:**	3
Extent of occurrence (m²):	420	**Percent cover of *H. vernicosus***	28%
Area covered by the population (m²):	118	**Density (no. shoots/m²):**	15,200
		Population estimation (shoots):	c. 1,793,600

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	1	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	NA	
	Density (no. shoots/m²)	NA	
Habitat for the Species:	No. of attributes passed	8	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.02	Non-intensive sheep grazing	Positive	Low	76-99	
K01.01	Erosion	Negative	High	1-25	

Site description:

Suitable habitat for *Hamatoculis vernicosus* at this site occurs within a flush surrounded by blanket bog. Colonies of *H. vernicosus* were found beside a swelling lawn of moss-dominated vegetation and in wet areas associated with the flush.

Much higher cover of *H. vernicosus* was recorded than when the population was discovered by Dr Neil Lockhart of NPWS in 1999, when a patch of c. 20cm x 20cm was recorded. The species may have spread since 1999 due to a decrease in grazing intensity; although the site was not searched in very great detail in 1999 (Neil Lockhart, pers. comm.). Some erosion was noted which could be as a result of former higher stocking levels as the current levels of grazing did not appear high. However, analysis of surface water samples taken from a monitoring stop in this area indicated some eutrophication.

Three monitoring stops were recorded at the site on very deep (>240cm) aqueous peat with c. 50% surface water in each stop. A number of associated species recorded in a relevé taken at the site by Dr Lockhart in 1999 were also recorded during the 2015–2017 survey: *Carex echinata, C. limosa, C. nigra, Holcus lanatus, Juncus bulbosus, Cardamine pratensis, Comarum palustre, Lychnis flos-cuculi, Potamogeton polygonifolius, Saxifraga hirculus, Ranunculus flammula, Calliergonella cuspidata, Straminergon stramineum* and *Warnstorfia exannulata*.

The Annex II and Flora (Protection) Order, 2015 listed and *Near Threatened Saxifraga hirculus* occurs in close proximity with *H. vernicosus* in the flush and co-occurred in two of the three monitoring stops recorded in the site during the 2015–2017 survey. The *Near Threatened* moss *Sphagnum teres* was also recorded in one of the stops.

Management recommendations:

Maintain current grazing regime and ensure that any erosion/eutrophication is not worsened by increasing stock levels.

Site Hv05 Owenbrin, Co. Mayo
001774 Lough Carra Mask Complex SAC

Summary site data:

Location (Irish Grid):	106247 262931	**Discovery map:**	38
Vice county:	West Galway (H16)	**Aerial photo no. (2005):**	O2530-D
Type of survey:	Monitoring	**No. of monitoring stops:**	4
Extent of occurrence (m²):	10,620	**Percent cover of *H. vernicosus*:**	58%
Area covered by the population (m²):	6,160	**Density (no. shoots/m²):**	12,400
		Population estimation (shoots):	c. 76,384,000

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	2	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	Pass	
	Density (no. shoots/m²)	Fail	
Habitat for the Species:	No. of attributes passed	7	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass*	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Fail	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

*Allowed to pass on expert judgement

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.01.02	Non-intensive sheep grazing	Positive	Medium	100	
A03.02	Non-intensive mowing	Positive	Low	100	
G01.03.01	Regular motorized driving	Neutral	Low	1-25	Tractor tracks

Site description:

Hamatocaulis vernicosus occurs at this site on the floodplain shores of Lough Mask, just north of where the Owenbrin River enters the lake. Overall, the site did not appear to have changed significantly since the baseline survey. The extent of occurrence was extended into the next field to the south-west, but this is due to increased search effort and not necessarily a genuine expansion of the population.

The substrate at this site is mostly silty loam and is quite different from the aqueous fen-peat found at the majority of *Hamatocaulis vernicosus* sites and the source of water comes from the lake (and possible river) flooding. The soil profiles at this site, noted during the baseline survey, consisted of a few centimetres of humic silty soil with a high clay element, which may impede drainage to a certain extent, overlying lacustrine sand.

When visited in August 2016, the site was quite dry and the water table was found to be up to 75cm below ground surface level. This is not unusual for this site as, during the baseline survey, wide fluctuations in water level were recorded in autumn and spring from 2009 to 2011. As the site is in the floodplain of Lough Mask it is inundated regularly. Therefore, the hydrology attribute was passed on expert judgement. It should be noted, however, that Lough

Mask has been downgraded from high ecological status to good ecological status by the EPA due to negative changes in hydromorphology and the hydrological condition at this site should be closely monitored in the next reporting period.

While the grasses *Agrostis stolonifera*, *Festca rubra* and *Nardus stricta* were recorded in the baseline survey, grass cover did not exceed 15% in any of the plots recorded. However, when surveyed in 2016 during the 2015–2017 survey, grass cover in all monitoring stops exceeded 40%, with grass cover in one stop reaching 70%. The mean percent grass cover across the monitoring stops was recorded as 54%, thus failing on this attribute. The aforementioned grass species were recorded, though none above 5% cover, with *Agrostis canina*, *A. capillaris*, *Holcus lanatus* and *Poa pratensis* also recorded at relatively high percent coverage. It is possible that increased nutrients from inundating lake water may be the cause and this situation would need to be monitored closely at this site. Mean percent cover of *Hamatocaulis vernicosus* across the monitoring stops recorded in 2016 had not decreased, in fact the result was slightly higher than the baseline. The density of shoots was slightly below the target set however.

Other associated species recorded include *Carex nigra, C. echinata, C. panicea, Juncus acutiflorus, J. bulbosus, Galium palustre, Ranunculus flammula, Veronica scutellata, Calliergonella cuspidata* and *Warnstorfia exannulata*.

The site is grazed by sheep and is regularly mown which is benefical to *Hamatocaulis vernicosus* at the site as it maintains open conditions and removes litter.

Management recommendations:

Maintain current grazing and mowing regime and monitor any agricultural improvements and changes in hydrology closely. It is recommended that surface water/groundwater samples be taken during the next round of monitoring.

Site Hv06 NW of Gortachalla Lough, Co. Galway
000297 Lough Corrib SAC

Summary site data:

Location (Irish Grid):	122500 237592	**Discovery map:**	45
Vice county:	West Galway (H16)	**Aerial photo no. (2005):**	O1349-B
Type of survey:	Monitoring	**No. of monitoring stops:**	4
Extent of occurrence (m²):	5,850	**Percent cover of *H. vernicosus*:**	36%
Area covered by the population (m²):	2,106	**Density (no. shoots/m²):**	23,900
		Population estimation (shoots):	c. 50,333,400

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	1	Unfavourable - Inadequate
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	Fail	
	Density (no. shoots/m²)	Fail	
Habitat for the Species:	No. of attributes passed	7	Favourable
	Area covered (m²)	Fail	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			UNFAVOURABLE - INADEQUATE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
G01.03	Motorised vehicles	Neutral	High	1-25	North of site
J02.07.01	Groundwater abstractions for agriculture	Negative	High	1-25	Drainage ditches

Site description:

This site lies in a former lake basin. *Hamatocaulis vernicosus* occurs here in transition mire to the east of acidic bog vegetation. Not much change could be seen since the baseline survey, apart from scrub clearance and digging in the north of the site, outside the extent of occurrence. There were vehicle tracks through a small area in the extent of occurrence in the very north of the site. The drainage ditch along the wall to the north-west of the site appeared to have been excavated somewhat since the last visit during the baseline survey in 2011. One monitoring stop situated near the wall had a much lower percentage cover of *H. vernicosus* than the baseline plot recorded in the same vicinity. Some new colonies were found in the north of the site. A monitoring stop in the north of the site (exactly located due to two diagonal corners marked with bamboo sticks left from the baseline survey) had a higher cover of *H. vernicosus* then recorded during the baseline survey. Comparatively high levels of surface water were present with a mean of 4cm recorded across the monitoring stops. If the drainage ditch along the wall is left to refill with vegetation naturally, or refilled/blocked in a sensitive manner, and as long as no further drainage activities take place, the overall Future prospects of the site are good.

Associated species include *Carex echinata, C. lasiocarpa, C. panicea, Eriophorum angustifolium, Comarum palustre, Lythrum salicaria, Mentha aquatica, Pedicularis palustris* and *Calliergon giganteum*. Monitoring stop 2 was very wet with a relatively high cover of *Hippuris vulgaris*, with *Menyanthes trifoliata*. Stops 3 and 4 had a more calcareous influence with *Campylium stellatum, Scorpidium scorpioides* and *S. cossonii* recorded.

The *Vulnerable* moss *Pseudocalliergon trifarium* occurs in the site and was recorded in monitoring stop 3.

Management recommendations:

Let the drain along wall at north-west of the site revegetate naturally or refill in a sensitive manner. Monitor the effects of scrub clearance to the north of the extent of occurrence.

Site Hv07 Scragh Bog, Co. Westmeath
000692 Scragh Bog SAC

Summary site data:

Location (Irish Grid):	242363 259070	**Discovery map:**	41
Vice county:	Westmeath (H23)	**Aerial photo no. (2005):**	O2631-D & O2701-B
Type of survey:	Monitoring	**No. of monitoring stops:**	7
Extent of occurrence (m²):	81,574	**Percent cover of *H. vernicosus*:**	19%
Area covered by the population (m²):	15,499	**Density (no. shoots/m²):**	26,800
		Population estimation (shoots):	c. 415,373,200

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	3	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	Pass*	
	Density (no. shoots/m²)	Pass	
Habitat for the Species:	No. of attributes passed	8	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

*Marginal fail of 1%; allowed to pass on expert judgement

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
X	No pressures or threats				

Site description:

No discernible change from the baseline was noted at this site. Scragh Bog lies in a lowland topogenous depression and contains most of the stages of a classical hydroseral succession from submerged and emergent communities through to fen carr and an embryonic raised bog community. *Hamatocaulis vernicosus* occurs mostly in the area of transition mire in the site, but also occurs in the alkaline fen. This is the largest known population of *H. vernicosus* in Ireland.

The GPS recording of *H. vernicosus* presence in the site was unchanged from the baseline survey, but the extent of occurrence polygon was digitised differently and included a much larger area. Therefore, the population size is considered unchanged overall.

Associated species occurring include *Carex lasiocarpa, C. limosa, Juncus acutiflorus, Angelica sylvestris, Caltha palustris, Comarum palustre, Filipendula ulmaria, Lychnis flos-cuculi, Mentha aquatica, Menyanthes trifoliata, Succisa pratensis, Equisetum fluviatile, Calliergonella cuspidata* and *Calliergon giganteum. Calluna vulgaris* and *Erica tetralix* were recorded in the monitoring stop with the lowest cover of *H. vernicosus* in the area of incipient raised bog vegetation.

The site is ungrazed and the biggest potential threats to *H. vernicosus* are eutrophication from surrounding farmland (although there is a natural buffer zone), drainage and natural succession over time. The site is protected as a Nature Reserve as well as an SAC.

The *Near Threatened Pyrola rotundifolia* was recorded in two monitoring stops in the site.

Management recommendations:

None, apart from no change to the current regime.

Site Hv08a Below Sgilloge Loughs, Co. Waterford
001952 Comeragh Mountains SAC

Summary site data:

Location (Irish Grid):	228390 111942	**Discovery map:**	73
Vice county:	Waterford (H6)	**Aerial photo no. (2005):**	O5624-C & O5694-A
Type of survey:	Monitoring	**No. of monitoring stops:**	4
Extent of occurrence (m²):	7,119	**Percent cover of *H. vernicosus*:**	35%
Area covered by the population (m²):	2,492	**Density (no. shoots/m²):**	14,400
		Population estimation (shoots):	c. 35,884,800

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	3	Favourable
	Extent of occurrence	Pass*	
	Mean % cover of *H. vernicosus*	Pass	
	Density (no. shoots/m²)	Pass	
Habitat for the Species:	No. of attributes passed	8	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

*Passed on expert judgement

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.01.02	Non-intensive sheep grazing	Positive	Medium	100	

Site Description:

Hamatocaulis vernicosus is found at this site in flushes among wet heath and blanket bog on the N-facing slopes below Sgilloge Loughs, a group of oligotrophic corrie lakes in the Comeragh Mountains.

A new bridge for walkers has been erected over the river to the north of the site since the last visit during the baseline survey in February 2011, when excavators had been seen in the area. New signposts have been erected for Nier Valley walks but far enough away from the extent of occurrence. The walking routes go through the flush systems, but not those areas with *H. vernicosus* occurring. Otherwise, no discernible change had occurred since the baseline survey.

Associated species recorded in the monitoring stops include *Juncus acutiflorus, J. bulbosus, Carex dioica, C. echinata, C. panicea, C. paniculata, Anthoxanthum odoratum, Holcus lanatus, Anagallis tenella, Cardamine palustris, Galium palustre, Leontodon autumnalis, Ranunculus flammula, Calliergonella cuspidata* and *Philonotis fontana*.

The site is grazed by sheep, but not at a level that is damaging to *H. vernicosus.*

Management recommendations:

Maintain current grazing regime.

Site Hv08b Nier River Valley, Co. Waterford
001952 Comeragh Mountains SAC

Summary site data:

Location (Irish Grid):	202707 406194	**Discovery map:**	73
Vice county:	Waterford (H6)	**Aerial photo no. (2005):**	O5693-B
Type of survey:	Monitoring	**No. of monitoring stop:**	2
Extent of occurrence (m²):	1,556	**Percent cover of *H. vernicosus*:**	35%
Area covered by the population (m²):	545	**Density (no. shoots/m²):**	41,000
		Population estimation (shoots):	c. 22,345,000

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	3	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	Pass	
	Density (no. shoots/m²)	Pass*	
Habitat for the Species:	No. of attributes passed	8	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

*Marginal fail, allowed to pass on expert judgement

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.01.02	Non-intensive sheep grazing	Positive	Medium	100	

Site description:

The site lies approximately 500m south-west of Hv08a Below Sgilloge Loughs. *Hamatocaulis vernicosus* occurs through a flush on a west-facing slope just above the riverbank in the Nier Valley.

A new bridge for walkers has been erected over the river to the north-east of the site, from which access can be gained to the site, since the last visit during the baseline survey in February 2011, when excavators had been seen in the area. New signposts have been erected for Nier Valley walks. However, this site is relatively remote and is unlikely to incur damage from walkers. No discernible change had occurred since the baseline visit.

Associated species recorded in the monitoring stops include *Carex echinata, C. nigra, C. panicea, Eriophorum angustifolium, Nardus stricta, Juncus acutiflorus, Anagallis tenella, Calluna vulgaris, Leoontodon autumnalis, Ranunculus flammula, Trifolium repens, Aulocomnium palustre, Calliergonella cuspidata, Sphagnum contortum* and *S. palustre*.

The site is grazed by sheep, but not at a level that is damaging to *H. vernicosus.*

Management recommendations:

Maintain current grazing regime.

Site Hv08c Coumtay, Co. Waterford
001952 Comeragh Mountains SAC

Summary site data:

Location (Irish Grid):	229846 108002	**Discovery map:**	75
Vice county:	Waterford (H6)	**Aerial photo no. (2005):**	O5765-A & O5765-B
Type of survey:	Full survey	**No. of monitoring stops:**	2
Extent of occurrence (m²):	64	**Percent cover of *H. vernicosus*:**	4%
Area covered by the population (m²):	2.6	**Density (no. shoots/m²):**	5,000
		Population estimation (shoots):	c. 13,000

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	1	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	NA	
	Density (no. shoots/m²)	NA	
Habitat for the Species:	No. of attributes passed	5	Unfavourable - Inadequate
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Fail*	
	Bryophyte cover (≥50%)	Fail	
	Cover of *Calliergonella cuspidata* (≤15%)	Fail	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Unfavourable - Inadequate
OVERALL ASSESSMENT:			Unfavourable - Inadequate

*Marginal fail of 2.5%

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.01.02	Non-intensive sheep grazing	Negative	High	100	

Site description:

Hamatocauslis verniosus was discovered at this site by Nick Hodgetts in 2007 as part of the Rare and Threatened Bryophytes surveys commissioned by NPWS.

During the 2015–2017 survey, *H. vernicosus* was refound at the site in the flush described by Hodgetts, on a south-facing slope at c. 430m altitude. While one small colony was found in 2007, further colonies were found through the flush and further down the slope. Other potentially suitable flushes in the area were searched, but *H. vernicosus* was not found.

Two monitoring stops were recorded at the site. Both were on shallow (25–35cm) peat overlying rock. There was a steady flow of water through the second stop. Grass cover in the two stops averaged 27.5%, failing the attribute target by 2.5%. The dominant grass in both plots was *Nardus stricta*, with *Molinia caerulea*, *Anthoxanthum odoratum* and *Holcus lanatus* recorded in smaller amounts.

Mean cover of *Calliergonella cuspidata* (28%) also failed the target set, as did mean bryophyte cover (40%). Other bryophytes recorded include *Aneura pinguis, Campylium stellatum, Dicranella palustris, Hylocomium splendens, Philonotis calcarea, Scapania undulata, Sphagnum contortum* and *Warnstorfia exannulata*.

Other species recorded in the monitoring stops include *Carex echinata, Juncus acutiflorus, J. bulbosus, J. squarrosus, Anagallis tenella, Cardamine pratensis, Leontodon autumnalis, Plantago lanceolata, Prunella vulgaris* and *Trifolium repens*.

The flush itself did not appear to be overgrazed (mean vegetation height was 18cm), but the site was more heavily grazed than the other two sites in the Comeragh Mountains SAC, Hv08a Below Sgilloge Loughs and Hv08b Nier Valley and the surrounding slopes were heavily overgrazed. There may be some eutrophication occurring at this site from overgrazing, as the water sample results indicated high levels of ammonium and total phosphate which may account for the grass and *Calliergonella cuspidata* cover targets failing. Therefore, grazing is regarded as a negative influence at this site.

Only a small population ('several dozen shoots over an area of c. 1m^2') was reported in 2007. The population recorded during the 2015–2017 survey, although somewhat larger than recorded in 2007, is still relatively small. The site may only ever have contained a small population in a marginal example of suitable habitat. It has persisted since 2007 when it was noted that the site was overgrazed. However, the future prospects for the habitat are not good if grazing levels are not reduced.

Management recommendations:

Reduce stocking levels of sheep.

Site Hv09 Commas, Co. Cavan
000584 Cuilagh-Anierin Uplands SAC

Summary site data:

Location (Irish Grid):	212985 327848	**Discovery map:**	26 (27A)
Vice county:	Cavan (H30)	**Aerial photo no. (2005):**	O1204-A (O1143-C)
Type of survey:	Full survey	**No. of monitoring stops:**	3
Extent of occurrence (m²):	748	**Percent cover of *H. vernicosus*:**	32%
Area covered by the population (m²):	239	**Density (no. shoots/m²):**	16,700
		Population estimation (shoots):	c. 3,991,300

Assessment data:

Parameter	*Attribute*	*Result*	*Assessment*
Population	No. of attributes passed	1	Favourable
	Extent of occurrence	Pass	
	Mean % cover of *H. vernicosus*	NA	
	Density (no. shoots/m²)	NA	
Habitat for the Species:	No. of attributes passed	8	Favourable
	Area covered (m²)	Pass	
	Hydrology	Pass	
	Tree cover (≤15%)	Pass	
	Shrub cover (≤20%)	Pass	
	Grass cover (≤25%)	Pass	
	Bryophyte cover (≥50%)	Pass	
	Cover of *Calliergonella cuspidata* (≤15%)	Pass	
	Mean vegetation height (≤40cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.01.02	Non-intensive sheep grazing	Positive	Medium	100	

Site description:

Hamatocaulis vernicosus was discovered at this site by Dr Rory Hodd during the National Survey of Upland Habitats in 2012 where a small population was recorded in a flush on the eastern slopes of Cuilcagh at Commas.

The 2015–2017 survey recorded *Hamatocaulis vernicosus* in the rich flush east of the summit of Cuilcagh, at c. 440m altitude. The flush extends several hundred metres down the slope and grades into poor *Juncus* flush vegetation. The population is much larger than previously estimated.

Three monitoring stops were recorded on saturated peaty substrate with associated species recorded included *Juncus articulatus, J. effusus, Carex echinata, C. nigra, C. panicea, Cardamine pratensis, Cirsium palustre, Epilobium palustre, Galium palustre, Montia fontana, Ranunculus flammula, Trifolium repens, Equisetum fluviatile, E. palustre, Brachythecium rivulare, Bryum pseudotriquetrum, Philonotis fontana, Sphagnum denticulatum* and *Warnstorfia exannulata*.

The area is grazed by sheep and this is not having any negative impact on the population or the habitat.

Management recommendations:

Maintain current grazing regime.