

NATIONAL PARKS AND WILDLIFE SERVICE



THE MONITORING AND ASSESSMENT
OF *PETALOPHYLLUM RALFSII*
(PETALWORT) IN THE REPUBLIC OF
IRELAND 2016–2018



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An Roinn Cultúir,
Oidhreacht agus Gaeltachta
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Main photograph:

Petalwort *Petalophyllum ralfsii* (male thallus), Christina Campbell



The monitoring and assessment of *Petalophyllum ralfsii* (Petalwort) in the Republic of Ireland 2016–2018

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Executive Summary

This report presents details of a monitoring survey conducted between February 2016 and May 2018 to assess the conservation status of the EU Annex II species *Petalophyllum ralfsii*, commonly known as Petalwort, a thallose liverwort found in the coastal habitats dune slacks and machair in the Republic of Ireland. The survey was carried out as part of the Rare Plants Monitoring Survey 2015–2018.

A selection of 22 of the 30 known *P. ralfsii* sites in the Republic of Ireland were surveyed during the 2016–2018 survey in the counties of Clare, Cork, Donegal, Dublin, Mayo, Galway, Kerry and Sligo. Thirteen of the sites had previously been surveyed in detail.

Assessments of three parameters, *Population*, *Habitat for the Species* and *Future prospects*, were undertaken at the 22 sites following an established monitoring protocol. Monitoring stops were recorded using plots measuring 1 m x 1 m. The extent of occurrence of *P. ralfsii* at each site was mapped. The percentage of suitable habitat within the extent of occurrence was estimated at each site. *Population* was assessed as Favourable at each site if *P. ralfsii* thalli were present. If the species was not found, then the *Population* assessment relied on the result of the *Habitat for the Species* assessment. *Habitat for the Species* at each site was assessed. At each monitoring stop, *Habitat for the Species* quality assessment data were collected on hydrology, percent shrub cover, percent grass cover, percent cover of bare ground 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.

All sites passed the *Population* and the *Habitat for the Species* assessments, apart from three sites in Co. Kerry: Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry. Thalli were not recorded at the three sites and each received an Unfavourable-Inadequate assessment for *Habitat for the Species*. The assessments failed on percentage bare ground at all three sites, percentage grass cover at Pr17c Kilshannig and Pr19 West of Inny Ferry, and mean vegetation height at Pr17c Kilshannig. The results indicate that these sites are not grazed appropriately for *P. ralfsii*, with some poaching and eutrophication occurring at Pr17c Kilshannig in particular, with natural succession occurring at all three sites.

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. Moderate levels of disturbance, such as from trampling by walkers, from vehicle usage and from grazing, were deemed beneficial as these activities, at appropriate levels, compress the ground, keep vegetation low and create and maintain open conditions for *P. ralfsii*.

Combining the assessments of the three parameters at each site resulted in 19 of the surveyed sites receiving an overall assessment of Favourable, while three sites, Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry, received an Unfavourable-Inadequate assessment.

At the national level, the *Population* parameter received a Favourable assessment. As *P. ralfsii* is an ephemeral species and may not be recorded due to prevailing conditions, it was decided that the extant status of a population at a site would be reviewed only after three successive six-yearly rounds of monitoring failed to record the species at the site. Therefore, the three sites where *P. ralfsii* was not found during the 2016–2018 survey are retained in the 2013–2018 reporting round, particularly as the possibility remains that they will be recorded in the next monitoring round as some potentially suitable habitat remains. The recommended population size unit for *P. ralfsii* for the 2013–2018 reporting period is the number of occupied 1 km x 1 km grid squares, which is 49 in the Republic of Ireland. The additional population unit reported on is ‘number of localities’, a locality being 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'. The number of localities reported in the 2013–2018 period is 30.

A total of 19 of the 22 surveyed sites (86%), 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 the results, the national conservation status assessment for the Annex II species *Petalophyllum ralfsii* was then evaluated, and a result of Favourable was obtained.

The report concludes with recommendations for improving the conservation status of the less favourably scored sites and for further research.

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1 Introduction

1.1 *Petalophyllum ralfsii*

Petalophyllum ralfsii (Wils.) Nees & Gottsche (Petalwort) is a thallose liverwort belonging in the family Petalophyllaceae (Crandall-Stotler *et al.*, 2002). It is distinguished from superficially similar species in the Fossombroniaceae by an undissected thallus and the presence of erect, almost parallel, lamellae that radiate from the axis and which are perpendicular to the flattened part of the thallus (Paton, 1999). Another distinguishing feature is that *P. ralfsii* has colourless rhizoids, whereas the rhizoids are purple in many *Fossombronia* species (except *F. caespitiformis* subsp. *multispira*). *P. ralfsii* can also be confused with *Moerckia flotoviana*, with which it can co-occur, but the thallus of the latter has very wavy margins and the sexual organs are covered by small, convex scales along the midrib (Atherton *et al.*, 2010).

P. ralfsii thalli can be solitary, in rosettes or in mats, each thallus generally measuring 1 mm to 10 mm in diameter. A subterranean rhizome-like axis which is tuberous at the apex of mature plants allows it to withstand long periods of desiccation (Paton, 1999), with the above-ground parts dying back during dry conditions in summer.

P. ralfsii is dioicous, i.e. the orange spherical male antheridia and the female archegonia, which are surrounded by erect involucre (bracts), occur on separate thalli. The species is often fertile (Paton, 1999). Sporophytes are produced regularly in late winter, spring and early summer. Spores are relatively large (40–56 µm) and may persist in the soil for long periods until environmental conditions become suitable for new plant production (Sim-Sim *et al.*, 2000). No specialised asexual propagules are known, but it can reproduce clonally by means of bifurcation whereby the thallus splits into two. Underground branches from the subterranean axes can also give rise to new thalli, which then become independent as the underground branches decay and presumably the process is continuous (Holyoak, 2000).



Figure 1 Thalli of *Petalophyllum ralfsii* at Sheskinmore, Co. Donegal, with immature and mature sporophytes.

Its chromosome number is 9 (Paton, 1999) and it is considered to be haploid (Rumsey *et al.*, 2001). Allozyme analysis carried out on *P. ralfsii* samples taken from 24 colonies in nine localities in Great Britain found monomorphism within 16 putative loci (Rumsey *et al.*, 2001). However, allozyme analysis only represents a small fraction of the genome and so the species may not totally lack genetic variation.

P. ralfsii has a Mediterranean-Atlantic distribution, occurring in Spain (the Balearic Islands), Portugal, Greece, Italy, Malta, Cyprus, Turkey, Morocco, Algeria and Tunisia in the Mediterranean region, including North Africa and Turkey, and extending northwards along the Atlantic seaboard to Britain and Ireland (Hill *et al.*, 1991).

P. ralfsii is known from 30 locations in the Republic of Ireland in the counties of Clare, Cork, Donegal, Dublin, Galway, Mayo, Kerry and Sligo (see Table 1). There are four localities where confirmed records of *P. ralfsii* have been reported, but where it is now thought to be extinct, or not seen in over 30 years. Details of these locations are found in Campbell *et al.* (2015).

Nearly all the *P. ralfsii* sites are found in coastal dune systems with damp, calcareous dune slacks or machair. In Ireland and Great Britain, *P. ralfsii* is a lowland calcicole and a pioneering species of bare moist stable, compact sand or of short turf mainly on mildly to strongly base-rich dune slacks and machair, where it is subject to inundation in the winter (Paton, 1999; Lockhart *et al.*, 2012a). The largest Irish populations are found in the west of Ireland on machair, which is listed as a priority habitat on Annex I of the EU Habitats Directive (EU Habitat code 21A0) and given the code CD6 in the Heritage Council classification scheme (Fossitt, 2000). *P. ralfsii* is found in dune slacks in the earlier stages of development and prefers soil that is compact and bare, for example at the sides of paths, and does not grow in slacks that are water-filled for long periods or that are heavily shaded (Church *et al.*, 2001; Lockhart *et al.*, 2012a). The habitat 'Humid Dune Slack' (EU habitat code 2190) is also listed on Annex I of the EU Habitats Directive (habitat CD5 Dune slack; Fossitt, 2000). The sites where *P. ralfsii* is found in Donegal could not be described as typical machair or dune slack habitat, however, as *P. ralfsii* grows on a flushed slope (Rosses Strand), on peaty sand above limestone (Sheskinmore), on thin humic sand over rock beside the shore (Keadew Point) and on a sandy track (Rosepenna). The site at Fanore, Co. Clare is also unusual as *P. ralfsii* grows there on damp soil *circa* 25 cm deep over limestone.

In Ireland, *P. ralfsii* is classified as *Least Concern* (Lockhart *et al.*, 2012a, 2012b). The Republic of Ireland may well be a centre of distribution for the plant, with some very large populations on west coast machair systems. Indeed, it seems likely that the Republic of Ireland holds the highest proportion of the world population of *P. ralfsii* of any country in the world, and probably the largest populations (Porley *et al.*, 2008). Therefore, Ireland has an international responsibility for its conservation. The species is protected through listing on the Flora (Protection) Order, 2015 (Statutory Instrument No. 356 of 2015).

Table 1 lists the known *P. ralfsii* sites in the Republic of Ireland, using the same site name and code (with the prefix 'Pr0' or 'Pr') as listed in Campbell *et al.* (2015), with the Special Area of Conservation (SAC) name and code listed, as well as the 1 km x 1 km Irish National Grid square(s) within which they occur.

Table 1 The site name and number of each of the 30 known *Petalophyllum ralfsii* sites in Ireland and the county, SAC name and code in which they occur.

Site no.	Site name	County	SAC name	SAC code	1 km x 1 km grid
Pr01	Rosses Point	Donegal	Tranarossan and Melmore Lough	IE0000194	C1142
Pr02	Rosepenna	Donegal	Sheephaven	IE0001190	C1237
Pr03	Tramore/Black Burrow/ SW of Dunfanaghy	Donegal	Horn Head and Rinclevan	IE0000147	B9836
Pr04a	Damph Beg	Donegal	Gweedore Bay and Islands	IE0001141	B8029
Pr04b	Derrybeg	Donegal	Gweedore Bay and Islands	IE0001141	B7926
Pr04c	Keadew Point	Donegal	Gweedore Bay and Islands	IE0001141	B7318
Pr05a	Dooy Point	Donegal	West of Ardara/Maas Road	IE0000197	B7502
Pr05b	Sheskinmore	Donegal	West of Ardara/Maas Road	IE0000197	G6895
Pr06	Bunduff Machair	Sligo	Bunduff Lough and Machair/Trawalua/Mullaghmore	IE0000625	G7056
Pr07	Garter Hill	Mayo	Glenamoy Bog Complex	IE0000500	F8040; F8041; F8139; F8239; F8140; F8240; F8340
Pr08a	Doolough Machair	Mayo	Mullet/Blacksod Bay Complex	IE0000470	F7322
Pr08b	Dooyork Machair	Mayo	Mullet/Blacksod Bay Complex	IE0000470	F7320
Pr09	North Inishkea	Mayo	Inishkea Islands	IE0000507	F5623
Pr10	Doogort Machair	Mayo	Doogort Machair/Lough Doo	IE0001497	F7009
Pr11	Keel Machair	Mayo	Keel Machair/Menaun Cliffs	IE0001513	F6404
Pr12	Dooaghtry	Mayo	Mweelrea/Sheeffry/Erriff Complex	IE0001932	L7468; L7568 F7469; F7569
Pr13	Omey Island Machair	Galway	Omey Island Machair	IE0001309	L5555; L5556 L5655
Pr14a	Mannin More	Galway	Slyne Head Peninsula	IE0002074	L6046
Pr14b	Truska Machair	Galway	Slyne Head Peninsula	IE0002074	L5745; L5845 L5846
Pr14c	Doon Hill/West of Aillebrack	Galway	Slyne Head Peninsula	IE0002074	L5742; L5842 L5843
Pr15	Murvey Machair	Galway	Murvey Machair	IE0002129	L6638; L6639
Pr16	Fanore	Clare	Black Head-Poulsallagh Complex	IE0000020	M1308
Pr17a	SW of Lough Naparka	Kerry	Tralee Bay and Magharees Peninsula, West to Cloghane	IE0002070	Q6116
Pr17b	Magherabeg	Kerry	Tralee Bay and Magharees Peninsula, West to Cloghane	IE0002070	Q6115
Pr17c	Kilshannig	Kerry	Tralee Bay and Magharees Peninsula, West to Cloghane	IE0002070	Q6217
Pr18a	Inch Spit	Kerry	Castlemaine Harbour	IE0002074	V6697; V6797
Pr18b	Rosbehy	Kerry	Castlemaine Harbour	IE0002074	V6491
Pr19	West of Inny Ferry	Kerry	Ballinskelligs Bay and Inny Estuary	IE0000335	V4768
Pr20	North Bull	Dublin	North Dublin Bay	IE0000206	O2437; O2438
Pr21	Barley Cove	Cork	Barley Cove to Ballyrisode Point	IE0001040	V7625; V7725

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 liverwort *Petalophyllum ralfsii* which took place from February 2016 to May 2018 as part of the RPMS. The results of the 2016–2018 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 2), to give an overall national assessment of conservation status for the species.

The 2016–2018 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.

Table 2 General evaluation matrix for assessment of Conservation Status (CS) of Annex II species (adapted from DG Environment, 2017).

Parameter	Conservation Status			
	Favourable ('green')	Unfavourable – Inadequate ('amber')	Unfavourable - Bad ('red')	Unknown
<i>Range</i>	Stable (loss and expansion in balance) or increasing <u>AND</u> 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 <u>OR</u> more than 10% below 'favourable reference range'	No or insufficient reliable information available
<i>Population</i>	Population(s) not lower than 'favourable reference population' <u>AND</u> 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 <u>AND</u> below 'favourable reference population' <u>OR</u> more than 25% below 'favourable reference population' <u>OR</u> reproduction, mortality and age structure strongly deviating from normal (if data available)	No or insufficient reliable information available
<i>Habitat for the species</i>	Area of habitat is sufficiently large (and stable or increasing) <u>AND</u> 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 <u>OR</u> habitat quality is bad, clearly not allowing long-term survival of the species	No or insufficient reliable information available
<i>Future prospects</i> (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' <u>OR</u> 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'

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 *Petalophyllum ralfsii* 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 29 known localities, in 20 SACs, in the Republic of Ireland. During the subsequent reporting period from 2007 to 2012, an additional locality was discovered, giving a total of 30 localities (sites), in 21 SACs. For the 2007–2012 reporting period, the agreed unit for reporting population size of *P. ralfsii* was 'area covered by the population in m²'. 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 thallus in the case of *P. ralfsii*, or a large genetically homogenous colony comprising thousands or even millions of individual thalli. The number of *P. ralfsii* thalli recorded at a site can also vary substantially depending on prevailing conditions at the time of survey. For the 2013–2018 reporting period, and to facilitate comparison between EU Member States, the recommended population size unit for *P. ralfsii* is now the number of occupied 1 km x 1 km 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 *P. ralfsii* in the Republic of Ireland is 'number of localities'.

To assess the *Habitat for the Species* parameter for *Petalophyllum ralfsii* 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 *Habitat for the Species* 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.

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 *Petalophyllum ralfsii* surveys in Ireland

Targeted surveys of *Petalophyllum ralfsii* began in 1998 as part of the NPWS programme of Rare and Threatened Bryophyte surveys. The species has now been recorded at 30 sites in the following counties: Kerry (six sites); Clare (one site); Galway (five sites); Dublin (one site); Mayo (seven sites); Sligo (one site); Donegal (eight sites) and Cork (one site) (Sources: NPWS Rare and Threatened Bryophyte database; Blockeel & Long, 1998; Hodgetts, 2003; Hodgetts, 2006; Holyoak, 1999; Holyoak, 2002; Holyoak, 2003; Holyoak, 2004; Lockhart, 1998a; Lockhart, 1998b). The most recent discovery of a population of *P. ralfsii* was at Barley Cove, Co. Cork in 2012 by Dr Neil Lockhart of NPWS and it is possible that further populations may yet be unrecorded due to the ephemeral nature of the plant, its small size and difficulty in identification.

As part of a PhD study (Campbell, 2013), a detailed field survey of 13 of the 30 *P. ralfsii* sites was undertaken in 2009–2011 to record information on population size, structure, associated vegetation and environmental variables. The results of that study at 12 sites (*P. ralfsii* was not found at one of the 13 sites) were used to produce a monitoring protocol for *P. ralfsii* 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 *P. ralfsii* submitted in 2013. The four parameters *Range*, *Population*, *Habitat for the Species* and *Future prospects* were determined to be Favourable for *P. ralfsii* (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 *P. ralfsii* locations. The percentage area of suitable habitat within each extent of occurrence polygon was then estimated, as not all microhabitats within the extent of occurrence area are suitable for *P. ralfsii*, some being, for example, too dry, too wet or too densely vegetated. This was used as the 'area covered by the population in m²' figure. Data on density and sex ratio of the species were also recorded in the monitoring stops and provide a basis for comparison in future monitoring programmes, although no specific targets were set due to the ephemeral nature of the species. From the analysis of data collected at 12 of the sites (*P. ralfsii* was not recorded at one of the 13 sites, Pr19 West of Inny Ferry), ecological indicators and associated targets were derived to assess the 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 and threats recorded and activities impacting positively on 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 2016–2018 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, are as follows:

- Undertake the monitoring of the conservation status of a representative sample of the known populations of *Petalophyllum ralfsii*, i.e. 22 selected sites, across the geographical and ecological range of the species in the Republic of Ireland using the methodology outlined in Campbell *et al.* (2015); 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 *P. ralfsii* in Ireland, using a sub-set of the known sites described in Campbell *et al.* (2015) survey, including the 13 sites surveyed in the baseline survey and an additional nine populations. Data from the 22 sites surveyed in 2016–2018 were used to evaluate the current national conservation status of *Petalophyllum ralfsii* in Ireland. The assessment process will be outlined in this report.

2. Methodology

2.1 Site selection

A sub-set of 22 *Petalophyllum ralfsii* sites in the Republic of Ireland were selected for survey by NPWS prior to commencement of the RPMS. Of the 22 sites, 12 sites that had been surveyed in detail during the baseline survey (Campbell, 2013; Campbell *et al.*, 2015) were selected for monitoring (see Table 5). The ten other populations, including Pr19 West of Inny Ferry where *P. ralfsii* was not found during the baseline survey, were also included for full surveys similar to that carried out by Campbell (2013). Figure 2 shows the location of the 22 *P. ralfsii* sites selected for the 2016–2018 survey superimposed on the national 10 km distribution map of *Petalophyllum ralfsii* from the 2007–2012 Article 17 report (NPWS, 2013).

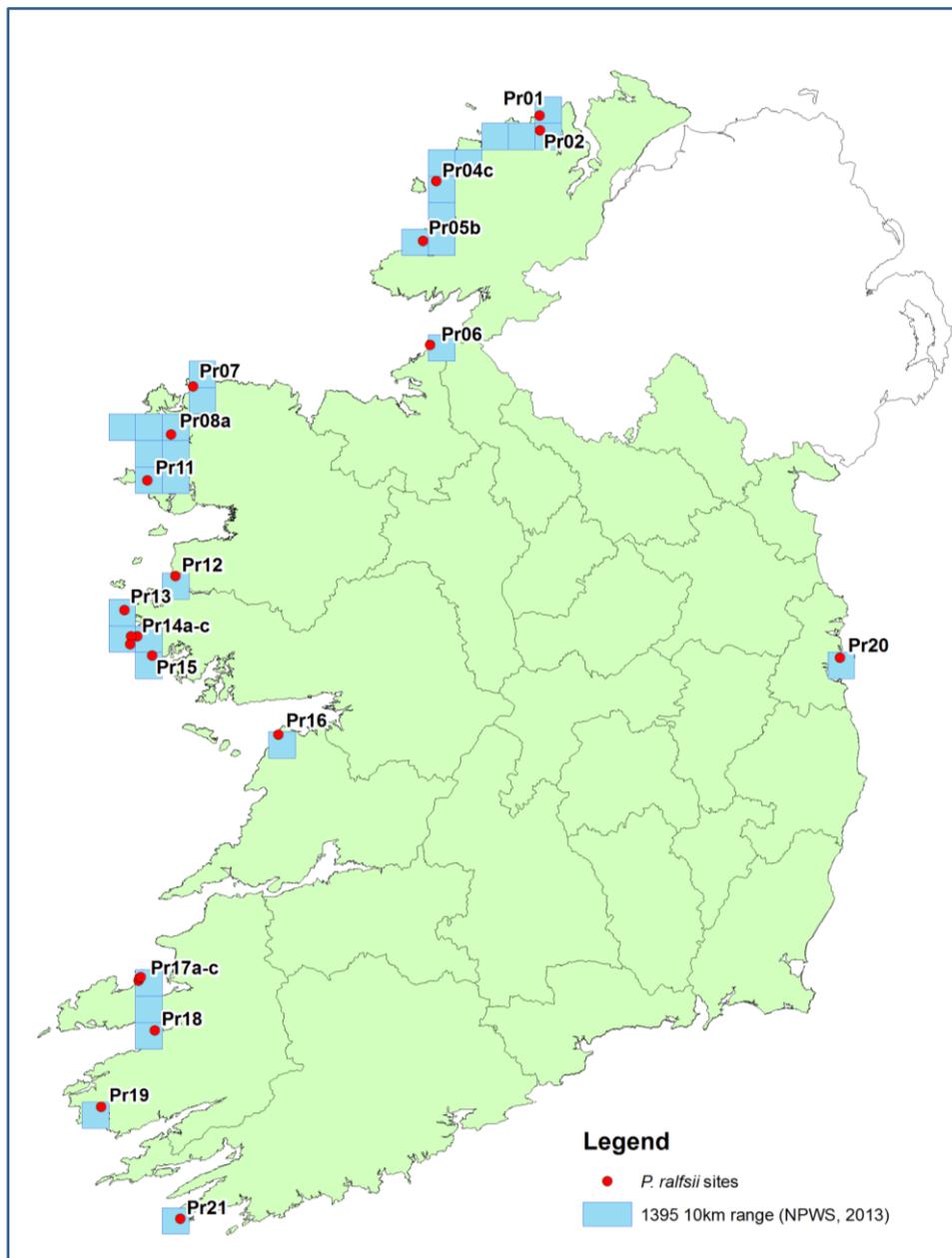


Figure 2 Location of the *Petalophyllum ralfsii* sites selected for survey 2016–2018 overlaid onto the national 10 km distribution of *P. ralfsii* (species code 1395) from the last round of reporting 2007–2012 (NPWS, 2013) in the Republic of Ireland. See Table 1 for site code key and further site details.

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 *Petalophyllum ralfsii* is listed on the Flora (Protection) Order, 2015 (FPO), a licence was obtained from NPWS that allowed collection of material for voucher specimens and identification purposes if necessary.

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) 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 spring/early summer of 2016, 2017 and 2018. Spring/early summer was chosen as the optimal time for surveying as *Petalophyllum ralfsii* thalli are most likely to be visible above ground and sporophytes are more likely to be observed at that time of year (Paton, 1999). Groundwater levels are more likely to be high then also, making excessive drainage easier to register. 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 of suitable habitat (m²)

The extent of occurrence (population envelope) of each *Petalophyllum ralfsii* population at the 22 selected 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 percentage area of suitable habitat within each 'extent of occurrence' polygon was then estimated by eye. This percentage was multiplied by the area of the extent of occurrence to give the figure for area of suitable habitat. This was summed where multiple 'extent of occurrence' polygons were present to give a total for the site.

2.3.2 Monitoring stop recording

Monitoring stops consisted of plots measuring 1 m x 1 m (1 m²) that were delineated on the ground using a wooden 1 m² quadrat. 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 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 five plots per site. As the survey was targeting *P. ralfsii*, the species had to be present in the monitoring stop. Where possible, monitoring stops were recorded where the baseline stops had been recorded, relocated using GPS point information; if not, they were placed where the species occurred in close proximity.

The following data were recorded at each monitoring stop for the *Habitat for the Species* assessment:

- Percent shrub cover in the monitoring stop
- Percent grass cover in the stop
- Percent cover of bare ground in the stop
- Mean vegetation height (cm) in the stop
- Depth of groundwater level (cm), estimated from a hole dug beside each stop

The number of thalli, including numbers of male, female, immature and mature sporophytes, were recorded in each monitoring stop for information purposes, but these data were not used in the assessment. A list of the associated species in each 1 m x 1 m stop was also recorded for information purposes, but again was not used in the assessment.

The term 'monitoring stop' is used for both monitoring plots and full survey plots where additional information following the methodology in Campbell (2013) was recorded at the sites not surveyed by Campbell (2013). This additional information includes other structural data in the 1 m x 1 m stops, such as the cover of sedges, rushes and fern/fern allies. Full relevés of 25 cm x 50 cm were also recorded, but again this information was not used in the assessment. Groundwater samples were also taken from each full survey plot for pH and conductivity analysis. Appendix 2 gives the full list of data items recorded in Turboveg at each monitoring stop. However, the additional information recorded during the 2016–2018 survey at the sites for full survey is not reported on in this Irish Wildlife Manual.

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 surveys 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 in square metres and hectares 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 each site.

- *Area of suitable habitat (m²):* This was calculated by multiplying the extent of occurrence (m²) by the percentage cover of suitable habitat estimated by eye.
- *Population thalli estimate:* In order to estimate the number of *P. ralfsii* thalli at each site, the number of thalli recorded in the monitoring stops was averaged across the stops. The mean number recorded across the monitoring stops was multiplied by the area of suitable habitat (m²) to give an overall population estimate.
- *Percentage female thalli:* Within each monitoring stop, the sex of each thallus was checked using a hand lens and numbers of female thalli were noted where evident. The numbers of female thalli recorded are expressed as a percentage of the total number of thalli recorded in the monitoring stops.
- *Percentage male thalli:* Within each monitoring stop, the sex of each thallus was checked using a hand lens and numbers of male thalli noted where evident. The numbers of male thalli recorded are expressed as a percentage of the total number of thalli recorded in the monitoring stops.
- *Percentage sporophytes:* Within each monitoring stop, the numbers of immature and mature sporophytes were noted where evident. The numbers of sporophytes recorded are expressed as a percentage of the total number of thalli recorded in the monitoring stops.
- *Impacts and activities:* Any impacts/activities negatively affecting the condition of the population and its habitat, such as undergrazing, 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 population and its habitat.
- *Site summary/Management:* A brief summary was written for each site, including notes on the general condition of the 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 recommended unit for estimating population of *Petalophyllum ralfsii* was ‘area covered by the population in m²’ (Evans & Arvela, 2011). As the RPMS began before the new guidelines for the 2013–2018 reporting period (DG Environment, 2017) were available, this unit was measured during the 2016–2018 monitoring survey. However, no targets for area covered by the population had been set by Campbell *et al.* (2015) for the *Population* assessment due to the ephemeral nature of *P. ralfsii*. Nevertheless, this unit was measured and, as it is essentially equivalent to ‘area of suitable habitat in m²’ in the case of *P. ralfsii*, is used for comparative purposes.

Due to the natural variability of the occurrence and density of *P. ralfsii*, targets involving thalli numbers were not set by Campbell *et al.* (2015). Therefore, the confirmation of the presence of the species at the site is the sole target result necessary to achieve a *Population* assessment of Favourable. In the case that the species cannot be found during the survey period at a site and the assessment for *Habitat for the Species* is given a Favourable status, then *Population* can also be given a Favourable status at that site. In the case that the species cannot be found during the survey period and the assessment for *Habitat for the Species* is given an Unfavourable-Inadequate or Unfavourable-Bad status, then *Population* can also be

given an Unfavourable-Inadequate or Unfavourable-Bad status respectively. This is summarised in Table 3.

Table 3 Summary of the *Population* assessment for *Petalophyllum ralfsii* followed during the 2016–2018 monitoring survey (adapted from Campbell *et al.*, 2015).

Attribute	Population assessment
Thalli present	Favourable
Thalli not present and Habitat for Species assessment is Favourable	Favourable
Thalli not present and Habitat for Species assessment is Unfavourable-Inadequate	Unfavourable-Inadequate
Thalli not present and Habitat for Species assessment is Unfavourable-Bad	Unfavourable-Bad

It was decided that if, after three cycles of 6-yearly monitoring, the species is still not found at a specific site (considering time of year, the prevailing conditions around the time of search, the site conditions, etc.) then the extant status of the population must be reviewed.

While counts of thalli were carried out, and population estimates were obtained per site for information purposes (see Section 2.3.4), these data were not used in the *Population* assessment.

The population size unit required for reporting under Article 17 for the 2013–2018 reporting period is number of 1 km × 1 km grids (DG Environment, 2017). To estimate this, the extent of occurrence polygons (population envelopes) recorded during the 2016–2018 survey and records from the NPWS Rare and Threatened Bryophyte surveys were intersected with the Irish National Grid (ING) 1 km square grid using ArcGIS.

2.4.2 Habitat for the Species assessment

The area of suitable habitat (m²) was estimated at each site. To measure this, the extent of occurrence (population envelope) of *P. ralfsii* at each of the surveyed sites was delimited with the aid of GPS points. The percentage of suitable habitat for *P. ralfsii* within each ‘extent of occurrence’ polygon is estimated by eye as not all microhabitats within the extent are suitable. The area of suitable habitat (m²) was calculated by multiplying the percentage estimated by each ‘extent of occurrence’ polygon and summed for each site.

Analysis of data collected during surveys at 12 *P. ralfsii* sites by Campbell (2013) suggested positive and negative indicators (attributes) to monitor in order to assess the quality of the habitat for *P. ralfsii*. These are outlined in Campbell *et al.* (2015) and were used to assess the quality of the *Habitat for the Species*. The attributes are hydrology, shrub cover (%), grass cover (%), cover of bare ground (%) and mean vegetation height (cm). These were recorded at the 1 m × 1 m 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.

Table 4 Summary of the *Habitat for the Species* assessment for *Petalophyllum ralfsii* followed during the 2016–2018 survey (based on Campbell *et al.*, 2015).

Attribute	Method of assessment	Target for pass at site level
Hydrology	Measurement (cm) of depth to groundwater level from ground surface (hole dug beside plot)	Mean groundwater depth should be ≤80 cm from ground surface; if bedrock present, substrate should be damp to touch
Hydrology (if bedrock reached before groundwater level)	Hand should be pressed onto soil surface	Soil surface should be wet/damp
Shrub cover (%)	Percent cover in a representative number of 1 m x 1 m monitoring plots	Mean percent shrub cover should not exceed 25%
Grass cover (%)	Percent cover in a representative number of 1 m x 1 m monitoring plots	Mean percent grass cover should not exceed 60%
Cover of bare ground (%)	Percent cover in a representative number of 1 m x 1 m monitoring plots	Mean percent cover of bare ground should exceed 5%
Mean vegetation height (cm)	Centimetres in a representative number 2 m x 2 m monitoring plots	Mean vegetation height should not exceed 6 cm in machair habitat/9 cm in dune slack habitat
<i>Habitat for the Species</i> assessment		Favourable = 5 attributes pass
		Unfavourable-Inadequate = 2–4 attributes pass
		Unfavourable-Bad = 0–1 attributes pass

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.

For *Petalophyllum ralfsii* 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 2 and using the guidance provided by the EU (DG Environment, 2017).

3 Results

3.1 Overall results

3.1.1 Sites surveyed during the 2016–2018 monitoring survey

The 22 *Petalophyllum ralfsii* sites selected for survey were visited in spring/early summer from February 2016 to May 2018. Seven of the nine sites not visited during the survey by Campbell (2013) were surveyed fully and the 15 remaining sites were monitored. The sites visited are listed in Table 5 outlining whether a full survey or monitoring survey was carried out and the number of monitoring stops recorded.

Table 5 The site code and name of the 22 *Petalophyllum ralfsii* sites surveyed during the 2016–2018 survey, the county in which they occur, the type of survey carried out and the number of monitoring stops (plots) recorded.

Site code	Site name	County	Type of survey	No. of plots
Pr01	Rosses Point	Donegal	Monitoring	2
Pr02	Rosepenna	Donegal	Monitoring	3
Pr04c	Keadew Point	Donegal	Monitoring	2
Pr05b	Sheskinmore	Donegal	Monitoring	4
Pr06	Bunduff Machair	Sligo	Monitoring	4
Pr07	Garter Hill	Mayo	Monitoring	5
Pr08a	Doolough Machair	Mayo	Full survey	1
Pr11	Keel Machair	Mayo	Full survey	4
Pr12	Dooaghtry	Mayo	Monitoring	5
Pr13	Omey Island Machair	Galway	Full survey	4
Pr14a	Mannin More	Galway	Full survey	4
Pr14b	Truska Machair	Galway	Monitoring	5
Pr14c	Doon Hill/West of Aillebrack	Galway	Full survey	3
Pr15	Murvey Machair	Galway	Full survey	4
Pr16	Fanore	Clare	Monitoring	3
Pr17a	SW of Lough Naparka	Kerry	Monitoring*	1
Pr17b	Magherabeg	Kerry	Monitoring	5
Pr17c	Kilshannig	Kerry	Monitoring*	1
Pr18a	Inch Spit	Kerry	Monitoring	5
Pr19	West of Inny Ferry	Kerry	Monitoring*	2
Pr20	North Bull	Dublin	Monitoring	3
Pr21	Barley Cove	Cork	Full survey	3

* *Petalophyllum ralfsii* was not found at three sites assigned for full survey, Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry. Thus, only *Habitat for the Species* assessment monitoring stops were recorded at these sites.

3.1.2 Extent of occurrence

Table 6 shows the extent of occurrence (m²) and the estimated area of suitable habitat (m²) recorded during the 2016–2018 survey. The extent of occurrence mapped and estimated area of suitable habitat recorded during previous surveys (Campbell, 2013; Campbell *et al.*, 2015; NPWS Rare and Threatened Bryophyte surveys) is also shown and a reason for change between surveys is given in the Notes column.

Table 6 The extent of occurrence (m²) and area of suitable habitat ('Area suitable' in m²) recorded at the 22 *Petalophyllum ralfsii* sites surveyed in 2016–2018 and comparison with those attributes recorded in the previous surveys (Campbell, 2013; Campbell *et al.*, 2015; NPWS Rare and Threatened Bryophyte surveys)

Site #	Site name	Extent of occurrence (m ²)		Area suitable (m ²)		Notes
		Baseline surveys	RPMS survey	Baseline surveys	RPMS survey	
Pr01	Rosses Point	25	23	20	18	Natural variability
Pr02	Rosepenna	2,246	3,678	1,123	1,839	Natural variability, difference in area mapped
Pr04c	Keadew Point	26	21	21	19	Natural variability
Pr05b	Sheskinmore	14	33,085	14	13,244	New area of occurrence
Pr06	Bunduff Machair	55	63	44	38	Small decrease in suitability
Pr07	Garter Hill	211,603	1,307,044	148,123	261,409	Larger area included
Pr08a	Doolough Machair	0.5	7.5	-	7.5	Full survey site mapped
Pr11	Keel Machair	10,267	10,689	-	6,413	Full survey site mapped
Pr12	Dooaghtry	159,647	101,812	95,788	58,563	Some natural succession; new area mapped; difference in area mapped
Pr13	Omey Island Machair	1,020	473	-	262	Full survey site mapped
Pr14a	Mannin More	19,970	10,819	-	4,104	Full survey site mapped
Pr14b	Truska Machair	71,924	51,584	46,750	30,211	Some natural succession
Pr14c	Doon Hill/West of Aillebrack	8	21,883	-	9,763	Full survey site mapped
Pr15	Murvey Machair	1.75	8,821	-	2,646	Full survey site mapped
Pr16	Fanore	45	59	35	47	Natural variability
Pr17a	SW of Lough Naparka	0.25	-	-	-	Species not found
Pr17b	Magherabeg	4,781	4,220	374	211	Difference in area mapped
Pr17c	Kilshannig	0.25	-	-	-	Species not found
Pr18a	Inch Spit	10,223	10,930	7,156	6,246	Natural variability
Pr19	West of Inny Ferry	0.5	-	0.5	-	Species not found
Pr20	North Bull	471	1,905	37	95	Difference in mapping
Pr21	Barley Cove	109.4	1,895	-	436	Full survey site mapped

For most sites, the difference between extent of occurrence figures are due to natural variability in the site (and taking a margin of error in GPS mapping into account). The area of extent of occurrence was mapped differently at Pr02 Rosepenna because a point marking a *P. ralfsii* colony recorded by David Holyoak in an area across the road from the main site was previously included in the mapping of the extent of occurrence; however, this area was fenced off when visited during the 2016–2018 survey and appeared no longer suitable. Similarly, at Magherabeg, an outlying record from 2003 recorded during the Rare and Threatened Bryophyte survey was included when mapping the extent of occurrence during the last round of reporting. This area was searched during the 2016–2018 survey, and though potentially suitable habitat was noted, the species was not recorded and so this area was omitted from the extent of occurrence polygon. A new area of *P. ralfsii* occurrence was found near the original population at Pr05b Sheskinmore where a large slack area at the back of the beach at Tramore Strand had become suitable for the pioneering *P. ralfsii* in the past few years. There was a small decrease in the percentage of suitable habitat at Pr06 Bunduff. A larger area was included within the extent of occurrence at Pr07 Garter Hill as the species occurs scattered throughout the site. It is also likely that the species occurs at further areas outside of the mapped extent, particularly to the east of the mapped extent where potentially suitable habitat still exists. At some points where *P. ralfsii* had been recorded during NPWS Rare and Threatened Bryophyte survey at Pr12 Dooaghtry, conditions were no longer suitable and appeared overgrown or otherwise too dry. This reduced the overall area of the extent of occurrence, but a new population was found to the east of the original population so overall there is sufficient suitable habitat at the site. Similarly, at Pr14b Truska, natural succession in some areas of the site has reduced the overall extent of occurrence. However, it was estimated that a lower percentage of suitable habitat was present in the extent of occurrence polygons also. The site appeared to be somewhat less heavily grazed than previously. Nevertheless, this system is dynamic and natural blow-outs regularly create new areas for *P. ralfsii* to colonise.

The sites selected for full survey were more accurately mapped than in the last round of reporting and there are not thought to be losses in extent of occurrence at these sites. *P. ralfsii* was not recorded at three sites in Co. Kerry, Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry. These sites are discussed further in subsequent sections in this report.

The total area of suitable habitat at the 22 sites surveyed is 395,572 m², while the area of suitable habitat at the remaining eight sites (not surveyed in 2016–2018), estimated from NPWS Rare and Threatened Bryophyte surveys, is 50 m² (see Campbell *et al.*, 2015) to give a national total of 395,622 m².

3.2 Population assessment

As the requirement for a site to pass the *Population* assessment was the presence of thalli, 19 of the 22 surveyed sites passed as thalli were recorded, the three exceptions being Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry. Because thalli were not found at these sites, the *Population* assessment of each site relied on the assessment of *Habitat for the Species* (see Table 3). Each of these three sites received a *Habitat for the Species* assessment of Unfavourable-Inadequate, therefore the *Population* assessment for each of them is also Unfavourable-Inadequate. However, because the extant status of the populations at these sites will not be reviewed until after three cycles of 6-yearly monitoring fail to record the species, these sites are retained in the national *Population* assessment for the 2013–2018 reporting period.

The population size unit required in the 2013–2018 reporting period for the *Population* assessment is 1 km x 1 km grids (DG Environment, 2017). The number of 1 km x 1 km grids within which *P. ralfsii* occurred during the 2013–2018 reporting period is 49. This includes the three populations at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry. It also includes a grid square (F8340) within which *P. ralfsii* was recorded in 1999 during the NPWS Rare and Threatened Bryophyte survey in the east of the Pr07 Garter Hill site (Holyoak, 2003). This part of the site was searched for *P. ralfsii*, but the species was not found during the 2016–2018 survey. However, areas of potentially suitable

habitat remain and so the grid square was retained. The total number of grid squares also includes those within which the eight *P. ralfsii* sites that were not surveyed during the 2016–2018 survey occur.

The additional population size unit reported on in the 2013–2018 reporting period is ‘number of localities’ which, as Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry are being retained, is 30 localities.

3.3 *Habitat for the Species* assessment

Assessment of the *Habitat for the Species* parameter during the 2016–2018 survey was carried out using the set of attributes outlined in Table 4.

All sites passed all attributes for the *Habitat for the Species* assessment, apart from the three sites where *P. ralfsii* was not recorded, i.e. Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry.

Areas of potentially suitable open habitat, with some bare ground, were searched thoroughly at each of the three sites, but did not yield thalli. Assessment plots were placed at points where previous relevé plots had been recorded at Pr17a SW of Lough Naparka (Lockhart, 1998a), Pr17c Kilshannig (Hodgetts, 2003) and Pr19 West of Inny Ferry (Lockhart, 1998b) during NPWS Rare and Threatened Bryophyte surveys. The assessments failed on percentage bare ground at all three sites, percentage grass cover at Pr17c Kilshannig and Pr19 West of Inny Ferry and mean vegetation height at Pr17c Kilshannig. The results indicate that these sites are not grazed appropriately for *P. ralfsii*, with some poaching and eutrophication at Pr17c Kilshannig.

As the area of suitable habitat at these three sites never exceeded 10 m² each, which is c. 0.00008% of the national total (c. 395,620 m²), it is deemed that *Habitat for the Species* assessment at the national level should remain Favourable in the 2013–2018 reporting period.

3.4 Pressures, threats and other activities

Prior to evaluating the *Future prospects* parameter, the activities, both positive and negative, recorded during the 2016–2018 survey at all *Petalophyllum ralfsii* sites were examined. These are shown in Table 7, with pressures and threats recorded as having a negative influence, and other activities having a neutral or positive influence. Depending on the context, the same activity may have either a positive, negative or neutral effect. The table also includes the frequency of the impacts by intensity (high, medium or low) and by the percentage of the extent of occurrence affected.

Grazing by a number of different grazing animals at a non-intensive level was the main activity noted, with cattle, sheep and rabbit (K04.05) being the most frequent type of grazer. Horse grazing (A04.02.03) and hare grazing (K04.05) were also recorded. Grazing, at appropriate levels, is recorded as having a positive influence as it prevents vegetation becoming rank, prevents scrub encroachment, and creates bare patches in the substrate which *P. ralfsii* can subsequently colonise. Two sites in particular, Pr07 Garter Hill and Pr12 Dooaghtry, are heavily grazed by sheep, which overall is a positive activity for *P. ralfsii*. However, this can cause localised erosion of the machair which is deemed to be a neutral impact for *P. ralfsii* as, despite being negative in the sense that it may disturb thalli present, it creates new habitat that will eventually be recolonised; however, it is negative for the machair habitat overall. Poaching (G05.01 Trampling, overuse) was recorded at Pr17c Kilshannig, around the area that formerly supported *P. ralfsii*. Effects of eutrophication could also be seen here as a high cover of grasses was recorded in the monitoring stop at the site. Therefore, cattle grazing was deemed to be a negative influence at this site. Cattle grazing was deemed to be neutral at Pr19 West of Inny Ferry as any positive influence was counterbalanced by slight eutrophication, a negative influence, at the site.

Table 7 Frequency (Freq) of impacts, by intensity (high (H), medium (M), low (L)), % of the extent of occurrence affected and influence (positive (Pos), negative (Neg), neutral (Neut)), at the *Petalophyllum ralfsii* sites surveyed in 2016–2018.

Impact code	Impact description	Intensity			% extent of occurrence affected						Influence			Freq
		H	M	L	<1	1-25	26-50	51-75	76-99	100	Pos	Neg	Neut	
A04.02	Non-intensive grazing (donkeys)			1						1	1			1
A04.02.01	Non-intensive cattle grazing	1	5	8	1				1	12	12	1	1	14
A04.02.02	Non-intensive sheep grazing	5	2	1						8	8			8
A04.02.03	Non-intensive horse grazing		1		1						1			1
A08	Fertilisation (dog faeces)			1	1							1		1
G01.02	Walking, horse-riding and non-motorised vehicles		5	10		2	4	7		2	15			15
G01.03.02	Off-road motorized driving		8	3		4	4	2	1		6		5	11
G01.08	Other outdoor sports & leisure activities			1		1							1	1
G02.01	Golf course		1			1							1	1
G05.01	Trampling, overuse	1				1						1		1
K01.01	Erosion	1		1		2							2	2
K02.01	Species composition change (succession)		1	4		2			3			5		5
K04.05	Damage by herbivores (including game species)	8	5	6						19	19			19
<i>Frequency</i>		16	28	36	2	14	8	9	5	42	62	8	10	80

Species composition change was noted in a number of sites, particularly at the three sites where *P. ralfsii* was not found, but also at Pr14b Truska, in areas at the most landward edges of the machair that were formerly suitable and in some areas where *P. ralfsii* was previously recorded. These areas no longer support suitable habitat and have become overgrown, with little/no bare ground present.

Other outdoor sports and leisure activities (G01.08) refers to the Ballyconneely races that take place on Aillebrack machair (at the site Pr14c Doon Hill/West of Aillebrack) every August. This event is held mostly outside the extent of occurrence and does not appear to be causing damage and so was assessed as neutral. A golf/pitch and putt course at Pr11 Keel Machair was also assessed as neutral.

Coastal erosion was recorded at Pr07 Garter Hill, where an area of machair that sloped down to the coast had been washed away since the baseline survey in 2011, leaving a sandy cliff c. 1-1.5 m high. This probably occurred during high impact storms that struck the west of Ireland in 2013/2014.

Overall, trampling, mostly by walkers, but also by horse-riding and non-motorised vehicles, is regarded as a positive impact as it keeps the ground compact, with low vegetation allowing *P. ralfsii* colonise and sustain itself. The habitat for *P. ralfsii* is mostly maintained by this activity at Pr16 Fanore and Pr20 North Bull, as well as by rabbit grazing. However, the threat of localised eutrophication from dog faeces exists where dog walkers use the sites.

Off-road vehicle use is deemed a positive impact where it occurs at an appropriate level. Vehicles compress the ground and keep vegetation low, and *P. ralfsii* is often recorded on trackways through machair and in vehicle wheel ruts. However, this activity can become damaging if it occurs at too high an intensity and too frequently causing the vegetation surface crust to be broken up on a continual basis, as *P. ralfsii* cannot establish in these conditions. This was noted as affecting small areas in some sites, and in these cases off-road vehicle usage is deemed to be a neutral impact overall.

No invasive non-native species were recorded within the extent of occurrence at any of the sites. However, *Hippophae rhamnoides* was noted as prevalent in parts of the nearby dune system at Pr17b Magherabeg. Encroachment of this invasive shrub is a possible threat, but the slack where *P. ralfsii* occurs is probably too wet for *H. rhamnoides* to invade.

Climate change was not recorded as an impact during the 2016–2018 survey, but it is likely to affect the distribution of *P. ralfsii* in Ireland in decades to come if average temperatures continue to rise.

3.5 Future prospects assessment

3.5.1 Site level assessment of Future prospects

Table 8 shows the *Future prospects* assessment for the 22 *P. ralfsii* sites surveyed in 2016–2018 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).

The *Future prospects* at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry are deemed to be Unfavourable-Inadequate. The species has not been recorded since 1998 at two of the sites, Pr17a SW of Lough Naparka and Pr19 West of Inny Ferry, or since 2003 at Pr17c Kilshannig when numbers of thalli recorded were low and in small areas of suitable habitat (see Table 6). *The Habitat for the Species* assessments at all three sites were Unfavourable-Inadequate. As there is no evidence to suggest that the *Habitat for the Species* will improve under the current management, the overall *Future prospects* for the *Population* and the *Habitat for the Species* are assessed as Unfavourable-Inadequate at all three sites.

Table 8 *Future prospects (FP) assessment for the 22 Petalophyllum ralfsii sites surveyed during the 2016–2018 survey. Fav = Favourable, U-I = Unfavourable-Inadequate.*

Site code	Site name	FP of Pop.	FP of Habitat	FP of site	Rationale
Pr01	Rosses Point	Fav	Fav	Fav	Grazed appropriately
Pr02	Rosepenna	Fav	Fav	Fav	Positive impacts of trampling and vehicle use outweigh negative threats of overuse
Pr04c	Keadew Point	Fav	Fav	Fav	Succession and creation of new suitable habitat in balance
Pr05b	Sheskinmore	Fav	Fav	Fav	Positive impacts overall; large area of new colonies
Pr06	Bunduff Machair	Fav	Fav	Fav	Suitable grazing. Blowouts at side of track outweigh negative impact of succession
Pr07	Garter Hill	Fav	Fav	Fav	Grazing levels beneficial to <i>P. ralfsii</i>
Pr08a	Doolough Machair	Fav	Fav	Fav	Grazing levels could be increased, but good prospects for survival
Pr11	Keel Machair	Fav	Fav	Fav	Positive impacts of grazing and trampling outweigh any negative pressures; golf course neutral
Pr12	Dooaghtry	Fav	Fav	Fav	Grazing levels beneficial to <i>P. ralfsii</i>
Pr13	Omev Island Machair	Fav	Fav	Fav	Positive impacts overall
Pr14a	Mannin More	Fav	Fav	Fav	Positive impacts overall
Pr14b	Truska Machair	Fav	Fav	Fav	Some succession but continuity of suitable habitat created by blow-outs and grazing in balance
Pr14c	Doon Hill/West of Aillebrack	Fav	Fav	Fav	Suitable grazing and positive impacts of vehicle use outweigh negative impacts of overuse by vehicles. Ballyconneely races occur annually but minimal impact
Pr15	Murvey Machair	Fav	Fav	Fav	Positive impacts overall
Pr16	Fanore	Fav	Fav	Fav	Positive impacts of walkers and rabbit grazing overall
Pr17a	SW of Lough Naparka	U-I	U-I	U-I	Unsuitable grazing regime and natural succession
Pr17b	Magherabeg	Fav	Fav	Fav	Positive impacts overall
Pr17c	Kilshannig	U-I	U-I	U-I	Unsuitable grazing regime, poaching occurring and evidence of eutrophication
Pr18a	Inch Spit	Fav	Fav	Fav	No negative pressures apparent
Pr19	West of Inny Ferry	U-I	U-I	U-I	Unsuitable grazing regime and natural succession
Pr20	North Bull	Fav	Fav	Fav	Positive impacts of walkers and rabbit grazing
Pr21	Barley Cove	Fav	Fav	Fav	Positive impacts of walkers and rabbit grazing; a small amount of scrambling but not damaging overall

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 2, to obtain the overall conservation assessment for *Petalophyllum ralfsii* at each of the 22 sites surveyed in 2016–2018. This resulted in 19 sites receiving a Favourable assessment across the three parameters and three sites receiving an Unfavourable-Inadequate assessment.

Table 9 Results of the overall conservation assessment at the site level when all three parameters were assessed during the 2016–2018 survey; Fav = Favourable; U-I = Unfavourable-Inadequate.

Site code	Site name	Population	Habitat for the Species	Future prospects	Overall
Pr01	Rosses Point	Fav	Fav	Fav	Fav
Pr02	Rosepenna	Fav	Fav	Fav	Fav
Pr04c	Keadew Point	Fav	Fav	Fav	Fav
Pr05b	Sheskinmore	Fav	Fav	Fav	Fav
Pr06	Bunduff Machair	Fav	Fav	Fav	Fav
Pr07	Garter Hill	Fav	Fav	Fav	Fav
Pr08a	Doolough Machair	Fav	Fav	Fav	Fav
Pr11	Keel Machair	Fav	Fav	Fav	Fav
Pr12	Dooaghtry	Fav	Fav	Fav	Fav
Pr13	Omey Island Machair	Fav	Fav	Fav	Fav
Pr14a	Mannin More	Fav	Fav	Fav	Fav
Pr14b	Truska Machair	Fav	Fav	Fav	Fav
Pr14c	Doon Hill/West of Aillebrack	Fav	Fav	Fav	Fav
Pr15	Murvey Machair	Fav	Fav	Fav	Fav
Pr16	Fanore	Fav	Fav	Fav	Fav
Pr17a	SW of Lough Naparka	U-I	U-I	U-I	U-I
Pr17b	Magherabeg	Fav	Fav	Fav	Fav
Pr17c	Kilshannig	U-I	U-I	U-I	U-I
Pr18a	Inch Spit	Fav	Fav	Fav	Fav
Pr19	West of Inny Ferry	U-I	U-I	U-I	U-I
Pr20	North Bull	Fav	Fav	Fav	Fav
Pr21	Barley Cove	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 *P. ralfsii* is assessed as stable as future threats and positive activities likely to occur are expected to be in balance overall. There is some potential for *P. ralfsii* to be recorded in the next reporting round at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry.
- 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 *P. ralfsii* is assessed as stable as any recorded negative impacts are not currently impacting significantly on the majority of the *Habitat for the Species*, with the balance of positive activities, such as appropriate grazing and appropriate disturbance activities, generally balancing out negative impacts such as erosion.
- The current conservation status of the *Habitat for the Species* parameter has been assessed as Favourable as >99% of the area of the habitat is in “good” condition with *Future prospects* good at 19 of the 22 surveyed sites (86%) 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 *P. ralfsii* 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 2 to obtain the overall national conservation assessment for *Petalophyllum ralfsii*.

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 *Petalophyllum ralfsii* 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 Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry were assessed as Unfavourable-Inadequate due to thalli not being recorded and the *Habitat for the Species* assessments at these sites being determined as Unfavourable-Inadequate. As the extant status of the populations will be reviewed after three cycles of 6-yearly monitoring of unsuccessful searches (and the possibility remains that the species will be recorded in the next reporting round), they are retained in the 2013–2018 reporting round. Therefore, the *Population* assessment at a national level is assessed as Favourable;
- the *Habitat for the Species* assessments at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry were assessed as Unfavourable-Inadequate. The area of the *Habitat for the Species* at these sites 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 inappropriate grazing at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry may be rectified with appropriate changes in management. The overall effects of positive impacts currently outweigh any negative impacts at 86% of the surveyed sites and overall *Future prospects* are deemed to be good.

Table 10 summarises this result.

Table 10 Summary of the national conservation assessment of *Petalophyllum ralfsii*, based on the results of the 2016–2018 survey.

Parameter	Conservation Status	Trend	Future prospects
<i>Population</i>	Favourable	Stable	Good
<i>Habitat for the Species</i>	Favourable	Stable	Good
OVERALL NATIONAL CONSERVATION ASSESSMENT	<i>Favourable</i>	<i>Stable</i>	

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 10 km × 10 km grid square. This is the Favourable Reference *Range* and so the *Range* parameter is also Favourable with a Stable trend.

3.7 *Petalophyllum ralfsii* inside and outside of the SAC network

In Ireland, any 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 an Annex II species listed as a QI and occurring within an SAC.

The vast majority of the extent of occurrence polygons at all 22 surveyed *P. ralfsii* 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 1). A small area (41.1 m²) of the extent of occurrence polygon at Tramore Strand in Pr05b Sheskinmore lies outside the boundary of West of Ardara/Maas Road SAC. Also, at Pr14c Doon Hill, West of Aillebrack, an area of 3,533 m² at the most northerly extent of occurrence polygon (10,102 m²) lies outside the boundary of Slyne Head Peninsula SAC.

4 Discussion

4.1 Conservation assessment of *Petalophyllum ralfsii*

4.1.1 Overall national conservation status of *Petalophyllum ralfsii*

Based on the results of the 2016–2018 survey, the overall national conservation status of *Petalophyllum ralfsii* is assessed as Favourable. *Population*, *Habitat for the Species* and *Future prospects* are all assessed as Favourable also. While there was no change in the overall national conservation status assessment of *P. ralfsii* between this monitoring period and the last, there are activities negatively impacting on *Population* and the *Habitat for the Species* at a local level that need to be addressed at three of the sites visited during the survey.

4.1.2 Population

The *Population* parameter was assessed solely on the presence of *P. ralfsii*. As the number and location of thalli within a site can vary considerably annually, and seasonally, depending on prevailing weather conditions, it is very difficult, and unreasonable, to set targets for thalli numbers, or for area of extent of occurrence. Also, in the case of *P. ralfsii*, a single thallus could be taken as an individual, although this does not take account of the fact that thalli might be connected by underground structures and genetically identical. Fluctuations in thalli numbers may not be indicative of overall trends and therefore caution must be exercised when making comparisons between monitoring periods also.

While targets cannot be set, it is still recommended to map the extent of occurrence at the sites and to estimate the percentage of suitable habitat present to allow comparison over subsequent monitoring periods and to understand the dynamics of species occurrence at a particular site, taking fluctuations into account.

Due to the difficulty of estimating bryophyte population size, the required unit for reporting on *Population* for the 2013–2018 Article 17 reporting period is the number of occupied 1 km x 1 km grid squares, which, although a broad unit, allows comparison across Member States. Fluctuations in thalli numbers may not be indicative of overall trends, but the number of 1 km x 1 km grids should remain stable.

P. ralfsii population size is estimated at 49 1 km x 1 km grids, which contain the 30 known localities in the Republic of Ireland. The three sites where *P. ralfsii* was not recorded during the 2016–2018 survey, Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry, are retained in this round of reporting. However, the species' extant status at Pr17a SW of Lough Naparka and at Pr19 West of Inny Ferry should be reviewed during the next reporting period 2019–2024, as the species has not been recorded at either site since 1998. If the recommended management measures are taken, there is the possibility that the species will be recorded again at these two sites and at Pr17c Kilshannig (where *P. ralfsii* was last seen in 2003). *P. ralfsii* was first recorded at Pr19 West of Inny Ferry by Scully in the late 1800s (Scully, 1890) and had persisted there for c. 100 years. With appropriate changes in management, the species may again be recorded at this site.

4.1.3 Habitat for the Species

Habitat for the Species in Favourable condition is characterised 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 shrubs, no increased nutrient input leading to increased/rank grass cover, open conditions with bare ground present, and a relatively low vegetation height to prevent shading and

which is indicative of suitable grazing regimes. On this basis, the majority of the surveyed sites (86%) were assessed as Favourable for *Habitat for the Species*, with the area in good condition estimated by adding up the area of surveyed 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.

The *Habitat for the Species* parameter at the three sites where *P. ralfsii* was not found during the 2016–2018 survey, i.e. at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry, was assessed as Unfavourable-Inadequate. The assessments at all three sites failed on percentage bare ground. A proportion of bare ground is required for *P. ralfsii* to establish and maintain itself and it is easily out-competed and shaded out as vegetation becomes denser. Targets for percentage grass cover were exceeded at Pr17c Kilshannig and Pr19 West of Inny Ferry and mean vegetation height was too high at Pr17c Kilshannig. *P. ralfsii* is found where there is a lack of nutrients and where appropriate grazing suppresses more competitive species and keeps sward height low. The results indicate that the sites are not grazed appropriately. Despite being grazed by cattle, there is an issue of inappropriate grazing patterns for *P. ralfsii*, and some poaching and eutrophication. Further investigation of groundwater nutrient status may be required. A change in management to sheep grazing in place of cattle grazing at these sites should result in more tightly grazed open conditions across the sites. It is possible that the species may be recorded in the next or subsequent reporting rounds if the changes in management are implemented, although the apparent loss may be down to natural succession rather than related to management, considering the fact that coastal systems are naturally dynamic.

P. ralfsii is a pioneer species and the large area at Pr05b Sheskinmore recently colonised by *P. ralfsii* demonstrates the ideal conditions for the species to colonise. Here, the vegetation is not long established and conditions are very open, with a large proportion of bare stabilising sand (a mean of 40% bare ground cover was recorded in the monitoring stops). While rabbit grazing occurs here, the conditions are naturally open until the vegetation becomes more established. The pioneering colonist life strategy (During, 1979) of *P. ralfsii* is very evident at this site with the clonal spread of *P. ralfsii* in large mats and the production of abundant sporophytes. This has also been observed at other sites, such as Pr07 Garter Hill, where newly created and revegetating blow-outs provide suitable habitat for large amounts of *P. ralfsii* thalli, which decrease over time as surrounding vegetation becomes more established (Campbell, 2013). Grazing, at appropriate levels, is beneficial to *P. ralfsii* as it helps maintain the optimal conditions of a low and open sward at more established sites, as *P. ralfsii* is a poor competitor and tolerant of only light shading.

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. Cattle, sheep and rabbit grazing was most common, but horse grazing was recorded as occurring at Pr07 Garter Hill. Hare grazing also takes place at some sites, and Donkey grazing was recorded at Pr14a Mannin More. It is important to achieve the right balance of grazing in order to conserve *P. ralfsii*. A reduction in grazing by livestock and rabbits may threaten the species at some sites, as it needs a short, open sward in order to compete. A light level of trampling by grazing animals can also be beneficial as it maintains open conditions. Any spread of coarser vegetation, because of a reduction in grazing, could constitute a threat to its survival. Scrub encroachment is also a potential threat, for example by *Hippophae rhamnoides*, a non-native species. This species occurs on dunes surrounding the slack at Pr17c Magherabeg; however, the slack is likely to be too wet for *H. rhamnoides* to establish. Conversely, too high a level of grazing may have a deleterious impact on *P. ralfsii* through excessive physical damage, soil erosion and an increased input of nutrients. However, the relatively high levels of grazing that are beneficial for *P. ralfsii* may not be so for the habitat within which it occurs, and thus a balance must be achieved when considering the management of the particular site overall.

Grazing, at appropriate levels for *P. ralfsii*, was deemed overall to be beneficial to the *Habitat for the Species* at the majority of sites surveyed in 2016–2018. While the machair habitat at some sites, particularly at Pr07 Garter Hill, is overgrazed, it maintains ideal conditions for *P. ralfsii* and it is the largest site in the Republic of Ireland for the species.

However, the negative effects of poaching and eutrophication have to be outweighed by the positive effects for the grazing regime to be regarded as beneficial. The grazing regime at Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry, where *P. ralfsii* was not recorded, is deemed to be inappropriate for the species, particularly at Pr17c Kilshannig where excessive poaching was recorded. There was also evidence of eutrophication at this site and at Pr19 West of Inny Ferry. A change in management to sheep grazing may restore suitable conditions for *P. ralfsii* at these sites, but further investigation of groundwater nutrients may also be required. Eutrophication of groundwater from overstocking and from run-off of adjacent agricultural land may also be implicated in the absence of *P. ralfsii* at these sites.

Another frequent positive impact recorded at the sites surveyed was use by walkers and non-motorised vehicles. Moderate amounts of disturbance through these activities is beneficial to the habitat for *P. ralfsii* as it maintains open low vegetation and compacts the ground allowing *P. ralfsii* to establish. The use of motorised vehicles recorded at many sites is also beneficial in this way, and *P. ralfsii* is often found on old trackways and in wheel ruts. However, too much disturbance from these activities, particularly the use of motorised vehicles, may destroy the integrity of the substrate and can break up the bryophyte crust. While *P. ralfsii* may eventually recolonise these areas, too much disturbance on a continual basis is detrimental to the ability of the species to establish and maintain itself.

Climate change has not been assessed as an impact at present, but it is likely to affect the distribution of *P. ralfsii* in Ireland in decades to come if average temperatures continue to rise. In Cornwall, *P. ralfsii* has apparently increased in recent years (D. Holyoak, pers. comm.) which may be as a result of climate change favouring the species. Coastal erosion of *P. ralfsii* habitat at Pr07 Garter Hill was recorded during the 2016–2018 survey, most likely due to the winter storms of 2013/14, and there is evidence that an increase in Atlantic storms over the last few decades could be due to climate change (Masselink *et al.*, 2016). An increase in extreme storm events may, on balance, be beneficial to *P. ralfsii*, through the creation of areas of bare sand that *P. ralfsii* can colonise. Also, although *P. ralfsii* is adapted to survive periods of desiccation as a dormant underground structure, it is not known how much desiccation it can withstand before it disappears completely.

5 Recommendations

5.1 Management recommendations

The management recommendation for most sites is to maintain the current management regime, particularly appropriate grazing levels at the majority of sites. Undergrazing can result in succession which would lead to more closed vegetation conditions and possibly scrub encroachment, causing *Petalophyllum ralfsii* to become out-competed and shaded out. Overgrazing, particularly by cattle, can lead to poaching, excessive erosion and eutrophication.

In order to restore favourable *Habitat for the Species* at the three sites where *P. ralfsii* was not recorded, Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry, a change to an appropriate grazing regime is required. A change in management from cattle to sheep (and rabbit) grazing may restore suitable conditions. It is also recommended that groundwater samples at the sites be analysed for nutrients as surrounding agricultural activities at the sites may also be implicated in the absence of the species at these sites. Any proposed changes in management needs to take place in consultation with the landowner to explain the rationale and importance of the proposed measures for the conservation of the species. Close monitoring of the sites will elucidate if the proposed measures have been successful.

It should be recognised that the management regimes of most habitats in *P. ralfsii* 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, e.g. commonage grazing at Pr07 Garter Hill and Pr12 Dooaghtry. Conservation management plans for the SACs within which *P. ralfsii* occurs should be drawn up in consultation with landowners in order to explain the importance of the management practices that benefit the species. Integrated management plans should address the requirements of both the species and the Annex I habitats within which it occurs, i.e. machairs and humid dune slacks. Appropriate grazing regimes that are beneficial to *P. ralfsii*, i.e. that maintain short open conditions for the species, but which are not damaging to the habitat, should be established in liaison with landowners. Safeguarding suitable habitat for *P. ralfsii* should also be considered when managing the requirements of any other species, for example, digging of pools for Natterjack toads (*Bufo calamita*). Maintenance of a seasonally high water table and unpolluted groundwater should also be objectives considered.

5.2 Further research

It has been suggested that the relatively large (40–56µm) spores of *Petalophyllum ralfsii* may persist in the soil for long periods until environmental conditions become suitable for new plant production (Sim-Sim *et al.*, 2000). Empirical studies on the longevity of *P. ralfsii* spores and also their dispersal capacity would provide further information on the chances of survival of the populations. Such studies would elucidate how likely a return of *P. ralfsii* to the three sites in Kerry, Pr17a SW of Lough Naparka, Pr17c Kilshannig and Pr19 West of Inny Ferry would be if suitable conditions were re-established.

Allozyme analysis of populations of *P. ralfsii* in Great Britain did not reveal any genetic diversity within or among populations (Rumsey *et al.*, 2001). However, analysis using DNA fingerprinting techniques, such as amplified fragment length polymorphism (AFLP), would be more informative in providing an assessment of genetic diversity within the Irish populations. Pre-screening for endophytic fungal contaminants would be required, however (Duckett *et al.*, 2006; Fernandez *et al.*, 2006). For example, AFLP analysis of the sole east coast site at Pr20 North Bull would elucidate if this population is genetically distinct from the west coast populations as its geographic location would suggest. Genetic fingerprinting data would also inform site conservation priorities.

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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.

Rare Plants Monitoring Survey 2015-18

Petalophyllum ralfsii

Survey details:

Date surveyed: _____	Surveyed by: _____
% suitable habitat within Extent of Occurrence _____	
Voucher taken: _____	Seasonal flooding evident (Y/N): _____

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 the surveyed 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. Pr01, Pr02, etc.
4. SITE_NAME: Site name, e.g. Rosses Strand, Rosepenna, etc.
5. PLOT_ID: Monitoring stop number, e.g. Pr01_Q1, Pr01_Q2 or Pr08a_R1, Pr08b_R2, for relevés recorded in the full survey sites
6. PLOT_AREA: 1 m x 1 m for monitoring stops; 50 cm x 25 cm for relevés in full survey sites.
7. SURVEYORS: Name of ecologist(s) recording the monitoring stop.
8. GRID_REF: Grid reference of the 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. ANNEX_I: EU Habitat code of Annex I habitat stop recorded in.
15. FOSSITT: Fossitt (2000) code of habitat stop recorded in.
16. MEAN_VEGHT: The mean height of vegetation (cm) in the stop measured by a ruler.
17. SHRUB_COV: Percent cover of shrubs in the stop.
18. GRASS_COV: Percent cover of grasses in the stop.
19. BAREGROUND: Percent cover of bare ground in the stop.
20. TOT_THALLI: Total number of *Petalophyllum ralfsii* thalli in the stop.
21. INDET_THALLI: Number of thalli in the stop whose sex cannot be determined.
22. MALE_THALLI: Number of male thalli in the stop.
23. FEMALE_THALLI: Number of female thalli in the stop.
24. IMMAT_SPOR: Number of thalli with immature sporophytes in the stop.
25. MATUR_SPOR: Number of thalli with mature sporophytes in the stop.
26. WATER_DPTH: Depth of water (cm) measured by a ruler/measuring tape in hole dug beside stop.
27. SUBSR_DES: Description of the substrate in the stop in full survey sites.
28. SOIL_DEPTH: Depth of the soil (cm) in the stop in full survey sites.
29. MAX_VEG_HT: Maximum vegetation height (cm) in the stop in full survey sites.
30. ROCK_COV: Percent cover of rock in the stop in full survey sites.
31. SURF_WATER: Percent cover of surface water in the stop in full survey sites.
32. LITTER_COV: Percent cover of litter in the stop in full survey sites.
33. DUNG_COV: Percent cover of dung in the stop in full survey sites.
34. TOTAL_VEG: Total percent cover of vegetation in the stop in full survey sites.
35. SEDGE_COV: Percent cover of sedges in the stop in full survey sites.
36. RUSH_COV: Percent cover of rushes in the stop in full survey sites.
37. FORB_COV: Percent cover of forbs in the stop in full survey sites.
38. FERN_COV: Percent cover of ferns/fern allies in the stop in full survey sites.
39. BRYO_COV: Percent cover of bryophytes in the stop in full survey sites.
40. LICHEN_COV: Percent cover of lichens in the stop in full survey sites.
41. ALGAE_COV: Percent cover of algae in the stop in full survey sites.
42. ASSOC_Q_REL: Number (plot ID) of the relevé (50 cm x 25 cm) associated with the 1 m x 1 m stop in full survey sites/number (plot ID) of the 1 m x 1 m stop associated with the relevé (50 cm x 25 cm) in full survey sites
43. REMARKS: Free text field for recording additional information about the monitoring 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 Pr01 Rosses Strand

000194 Tranarossan and Melmore Lough SAC

Summary site data:

Location (Irish Grid):	211860 442807	Discovery map:	2
Vice county:	West Donegal (H35)	Aerial photo no. (2005):	O0040-D
Extent of occurrence (ha):	0.0023	Type of survey:	Monitoring
Area of suitable habitat (m²):	18	No. of monitoring stops:	3
Population thalli estimate:	108	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
K04.05	Damage by herbivores (including game species)	Positive	Low	100	Rabbit grazing

Site description:

This site is located on a south-facing hillside above the north end of Rosses Strand. Monitoring stops were recorded on the flushed slope on sandy humic soil overlying bedrock at a depth of 30–40 cm. There were no major discernible changes to the site since the baseline survey, apart from a few more tussocks of *Schoenus nigricans* present near monitoring stop 1 (Pr01_Q1). Less thalli were seen than on previous visits, but this was probably due to seasonal variation, and the habitat for the species is in good condition.

Associated species recorded include *Festuca ovina*, *F. rubra*, *Carex panicea*, *Schoenus nigricans*, *Bellis perennis*, *Orchis mascula*, *Pilosella officinarum*, *Plantago lanceolata*, *Prunella vulgaris*, *Thymus polytrichus*, *Trifolium repens*, *Selaginella selaginoides*, *Aneura pinguis*, *Ctenidium molluscum*, *Fissidens dubius*, *Plagiomnium undulatum*, *Scapania aspera* and *Trichostomum crispulum*.

Cattle grazing was evident by dung present and the site is grazed by rabbits. It is recommended that no change to the grazing regime takes place as undergrazing would lead to shading and competition from higher plants and overgrazing could lead to increased erosion on the steep slopes where *P. ralfsii* occurs.

Management recommendations:

Maintain current management regime.

Site Pr02 Rosepenna 001190 Sheephaven SAC

Summary site data:

Location (Irish Grid):	212034 437329	Discovery map:	2
Vice county:	West Donegal (H35)	Aerial photo no. (2005):	O0078-D, O0079-C
Extent of occurrence (ha):	0.368	Type of survey:	Monitoring
Area of suitable habitat (m²):	1,839	No. of monitoring stops:	3
Population thalli estimate:	11,034	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0%

Assessment data:

Parameter	Attribute	Result	Assessment
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	51-75	Walkers, horses
G01.03.02	Off-road motorized driving	Positive	Medium	26-50	Tyre tracks present
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing

Site description:

This site is located in an area east of the R248 road between the road and a ridge of low dunes. *Petalophyllum ralfsii* occurs in low vegetation on compact sandy soil on a trackway used by walkers and with light off-road vehicle usage. Horse hoofprints and tyre tracks were present and this, as well as trampling by walkers and grazing by rabbits, keeps the vegetation low and open. Many more thalli were seen than during the baseline survey by Campbell (2013) when only one thallus was recorded. During the 2016–2018 survey, the site was visited in March 2016 during a very wet spring which may have contributed to the increase in thalli recorded at this site. Overall, the site appears unchanged from the baseline.

P. ralfsii was also recorded by Dr David Holyoak in 1999 in a small area west of the road in an area where turf had been cut for use elsewhere on the nearby golf course. When this area was visited by Dr Neil Lockhart in 2006 he described it as no longer suitable. This area was fenced when visited during the 2016–2018 survey and so was not accessed, but the habitat looked unsuitable for *P. ralfsii*.

Associated species recorded include *Festuca rubra*, *Carex panicea*, *Bellis perennis*, *Lotus corniculatus*, *Plantago lanceolata*, *Prunella vulgaris*, *Ranunculus bulbosus*, *Trifolium repens*, *Aneura pinguis*, *Bryum pseudotriquetrum*, *Campyliadelphus chrysophyllus*, *Cratoneuron filicinum*, *Ctenidium molluscum*, *Didymodon fallax*, *Drepanocladus polygamus* and *Hypnum lacunosum*.

Continued use of the site by walkers, for horse-riding and for off-road driving, as well as continued rabbit grazing, would be beneficial to *P. ralfsii* to keep the vegetation short and open and to assist in the creation of new areas of bare soil for *P. ralfsii* to colonise. However, too high a level of horse-riding/off-road driving on a continuous basis would be damaging if the surface crust is continually broken up as vegetation cannot establish and, while this was not observed at the site during the 2016–2018 survey, this would need to be monitored in future surveys.

Management recommendations:

Maintain current management regime.

Site Pr04c Keadew Point

001141 Gweedore Bay and Islands SAC

Summary site data:

Location (Irish Grid):	173281 418115	Discovery map:	1
Vice county:	West Donegal (H35)	Aerial photo no. (2005):	O0199-C, O0224-A
Extent of occurrence (ha):	0.0021	Type of survey:	Monitoring
Area of suitable habitat (m²):	19	No. of monitoring plots:	2
Population thalli estimate:	247	Percentage male thalli:	Indeterminate
Percentage female thalli:	15.4%	Percentage sporophytes:	3.8%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	51-75	Walkers
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing

Site description:

No discernible change had occurred at the site since the baseline survey. Potentially suitable habitat was still present where the baseline plot 1 had been recorded, but the species was not found at this exact location. Thalli were found in nearby suitable habitat, however, in short open vegetation, demonstrating that there is a continuity of suitable habitat present at the site for *Petalophyllum ralfsii*, a pioneer species, and a monitoring stop was recorded here. Stop 2 was recorded in approximately the same location as the baseline plot, in short vegetation overlying a rocky outcrop above the shoreline.

During the baseline survey in 2009, a further area where *P. ralfsii* had been recorded by David Holyoak in 2002 was searched, but was found to be overgrown by vegetation and was unsuitable for *P. ralfsii*. This area was visited during the 2016–2018 survey, but again the habitat was unsuitable with a closed, relatively high vegetation sward occurring. This is due to natural succession and, as long as there is a continuity of enough suitable habitat and conditions remain naturally dynamic at the site, it is not regarded as a negative pressure for the species.

Associated species recorded in the monitoring stops include *Ammophila arenaria*, *Festuca rubra*, *Koeleria macrantha*, *Carex flacca*, *Bellis perennis*, *Daucus carota*, *Lotus corniculatus*, *Pilosella officinarum*, *Plantago coronopus*, *P. lanceolata*, *Succisa pratensis*, *Thymus polytrichus*, *Trifolium repens*, *Aneura pinguis*, *Bryum pallens*, *Ditrichum gracile*, *Entodon concinnus* and *Trichostomum crispulum*.

The site is used by walkers/dog walkers and this light trampling is beneficial for *P. ralfsii*. Rabbit grazing is relatively high at this site which is also beneficial in maintaining open conditions with low vegetation.

Management recommendations:

Maintain current management regime.

Site Pr05b Sheskinmore
000197 West of Ardara/Maas Road SAC

Summary site data:

Location (Irish Grid):	168979 3895452	Discovery map:	10
Vice county:	West Donegal (H35)	Aerial photo no. (2005):	O0390-C
Extent of occurrence (ha):	3.31	Type of survey:	Monitoring
Area of suitable habitat (m²):	13,244	No. of monitoring stops:	4
Population thalli estimate:	1,150,932	Percentage male thalli:	Indeterminate
Percentage female thalli:	7.6%	Percentage sporophytes:	4.8%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Medium	1-25	In rocky knoll area
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	51-75	Walkers in area beside caravan park
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing

Site description:

No change had occurred since the baseline survey in the area where the original population was recorded at this site. Much wetter conditions were noted when visited in spring 2016, with standing water noted below the rocky knoll beside where the *Petalophyllum ralfsii* population was recorded on a sloping bank. Less thalli were recorded in this area than during the baseline survey, but this is deemed to be due to natural variation in numbers and the area is still suitable. Species recorded in this area include *Carex flacca*, *Festuca rubra*, *Luzula campestris*, *Bellis perennis*, *Cerastium fontanum*, *Lotus corniculatus*, *Pilosella officinarum*, *Plantago lanceolata*, *Prunella vulgaris*, *Ranunculus bulbosus*, *Thymus polytrichus*, *Trifolium repens*, *Aneura pinguis*, *Brachythecium albicans*, *Bryum pallens*, *Calliergonella cuspidata*, *Ctenidium molluscum*, *Ditrichum gracile*, *Entodon concinnus*, *Hylocomium splendens*, *Lophocolea bidentata*, *Scapania aspera*, *Trichostomum crispulum* and *Peltigera membranacea*. Cattle grazing, as well as rabbit grazing, occurs in this area.

The second population was discovered in 2012 by NPWS staff in an area at the north of Tramore Strand near the caravan park. The extent of occurrence was mapped over a large slack area at the back of the beach at Tramore Strand. Conditions have become suitable here for the pioneering *P. ralfsii* in the past few years as vegetation has established and the sand has stabilised. Large areas of standing water were present throughout the extent of occurrence and open (40% bare ground) was recorded in both stops

recorded in this area) sandy compact turf with low vegetation contained large numbers of thalli with many sporophytes seen. In places, thalli were observed as occurring in dense mats. Associated species recorded in this area include *Ammophila arenaria*, *Holcus lanatus*, *Festuca rubra*, *Juncus articulatus*, *Plantago coronopus*, *Prunella vulgaris*, *Sagina procumbens*, *Aneura pinguis*, *Bryum* sp., *Ctenidium molluscum*, *Didymodon insulanus*, *Riccardia multifida* and *Nostoc* sp. This area is used by walkers and is grazed by rabbits. The area is close to the caravan park and is accessed by walkers/dog walkers and, while not a recorded as a currently occurring pressure, the area may be under potential threat from litter and excessive dog faeces.

The Near Threatened moss *Rhodobryum roseum* was recorded in the rocky knoll area of the site.

Management recommendations:

Maintain current management regime.

Site Pr06 Bunduff Machair

000625 Bunduff Lough and Machair/Trawalua/Mullaghmore SAC

Summary site data:

Location (Irish Grid):	170724 356243	Discovery map:	16
Vice county:	Sligo (H28)	Aerial photo no. (2005):	O0711-D
Extent of occurrence (ha):	0.0063	Type of survey:	Monitoring
Area of suitable habitat (m²):	38	No. of monitoring stops:	4
Population thalli estimate:	1,368	Percentage male thalli:	Indeterminate
Percentage female thalli:	2.8%	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
K04.05	Damage by herbivores (including game species)	Positive	Medium	100	Rabbit grazing

Site description:

The site has not changed since the baseline survey when thalli were found along a track at the eastern edge of a dune slack. During the NPWS Rare and Threatened Bryophyte survey, thalli were found at the base of the dune at the edge of the slack and along a vehicle track to the south-west of the baseline population, but no thalli were recorded in either of these areas during the baseline survey by Campbell (2013) or during the 2016–2018 survey, although potentially suitable habitat remains in places.

The track along the side of the slack, which was surveyed in 2016, was still found to be suitable, especially along the raised eastern edges of the track, although there appeared to be slightly denser vegetation in some parts of the track. A large amount of standing water was noted in the slack itself during the 2016–2018 survey in 2016.

Associated species recorded include *Ammophila arenaria*, *Festuca rubra*, *Holcus lanatus*, *Luzula multiflora*, *Centaurium erythraea*, *Erophila verna*, *Lotus corniculatus*, *Ranunculus bulbosus*, *Rumex acetosa*, *Scorzoneroides autumnalis*, *Thymus polytrichus*, *Trifolium repens*, *Equisetum palustre*, *Selaginella selaginoides*, *Aneura pinguis*, *Brachythecium albicans*, *Bryum pseudotriquetrum*, *Calliergonella cuspidata*, *Climacium dendroides*, *Cratoneuron filicinum*, *Ditrichum gracile*, *Hypnum lacunosum*, *Pseudoscleropodium purum* and *Syntrichia ruralis* subsp. *ruraliformis*.

The site is currently grazed by cattle and rabbits.

Management recommendations:

Maintain current grazing regime.

Site Pr07 Garter Hill

000500 Glenamoy Bog Complex SAC

Summary site data:

Location (Irish Grid):	81975 340433	Discovery map:	22
Vice county:	Sligo (H28)	Aerial photo no. (2005):	O0884-C/D, O0935-A/B
Extent of occurrence (ha):	130.7	Type of survey:	Monitoring
Area of suitable habitat (m²):	261,409	No. of monitoring stops:	5
Population thalli estimate:	7,319,452	Percentage male thalli:	Indeterminate
Percentage female thalli:	7%	Percentage sporophytes:	0.7%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤80 cm depth)	Pass	
	Shrub cover (≤25%)	Pass	
	Grass cover (≤60%)	Pass	
	Cover of bare ground (≥5%)	Pass	
	Mean vegetation height (<6 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Medium	76-99	
A04.02.02	Non-intensive sheep grazing	Positive	High	100	
A04.02.03	Non-intensive horse grazing	Positive	Medium	1-25	
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	1-25	
K01.01	Erosion	Neutral	High	1-25	
K04.05	Damage by herbivores (including game species)	Positive	Medium	100	Rabbit/Hare grazing

Site description:

Overall, this large machair site had not changed greatly since the baseline survey. However, there was some coastal erosion where the machair had sloped down to the rocky beach in an area where a baseline plot had been recorded, leaving sandy cliffs c. 1 m to 1.5 m high. This may be the result of particularly damaging storms that battered the west coast of Ireland in 2013/2014. A monitoring stop was placed in nearby suitable habitat containing *P. ralfsii*. The site was a lot wetter than on previous visits and there were large amounts of standing water present at the site when visited during a particularly wet spring in 2018.

A larger area of extent of occurrence was recorded at the site than previously as the species occurs scattered in areas of suitable habitat in dune areas as well as on the machair. The species was recorded in flushed areas high up the slopes at the back of the machair also.

The area to the east of the site where Dr David Holyoak had recorded *P. ralfsii* in 1999 as part of the NPWS Rare and Threatened Bryophyte surveys was searched during the 2016–2018 survey, but the

species was not found. Some areas of potentially suitable habitat remain, however, and the species may be recorded here again in future surveys.

Associated species include *Festuca rubra*, *Koeleria macrantha*, *Carex arenaria*, *C. panicea*, *Bellis perennis*, *Cerastium fontanum*, *Plantago coronopus*, *Prunella vulgaris*, *Sagina procumbens*, *Scorzoneroideis autumnalis*, *Trifolium repens*, *Aneura pinguis*, *Bryum pseudotriquetrum*, *Ctenidium molluscum*, *Distichium inclinatum*, *Ditrichum gracile*, *Homalothecium lutescens*, *Hypnum lacunosum*, *Plagiochila porelloides* and *Pseudocrossidium hornschurchianum*.

New signage for no dumping and no dogs allowed had been erected since the baseline site visits which appeared to be working as less dumping was observed at the site than on previous visits.

The machair itself was very overgrazed by sheep and large amounts of dung were observed during the 2016–2018 survey. Overgrazing favours *P. ralfsii* by creating and maintaining open conditions for the species to establish and maintain itself, and keeps a low sward which eliminates shading for *P. ralfsii*. Overgrazing has caused some localised erosion in places. This is deemed to be a neutral impact for *P. ralfsii* as, despite being negative in the sense it may disturb thalli present, it creates new habitat that will eventually be recolonised. The benefits of grazing outweigh the negative effect of dung which could potentially cause eutrophication. The site is also grazed by cattle. Some localised erosion around a ring-feeder was noted in one part of the site, although this was outside the extent of occurrence.

Management recommendations:

Maintain current management regime for *P. ralfsii*.

Site Pr08a Doolough Machair

000470 Mullet/Blacksod Bay Complex SAC

Summary site data:

Location (Irish Grid):	73605 322387	Discovery map:	22
Vice county:	West Mayo (H27)	Aerial photo no. (2005):	O1235-D
Extent of occurrence (ha):	0.0008	Type of survey:	Full survey
Area of suitable habitat (m²):	7.5	No. of monitoring stops:	1
Population thalli estimate:	13	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤80 cm depth)	Pass	
	Shrub cover (≤25%)	Pass	
	Grass cover (≤60%)	Pass	
	Cover of bare ground (≥5%)	Pass	
	Mean vegetation height (<9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
A04.02.02	Non-intensive sheep grazing	Positive	Low	100	
K04.05	Damage by herbivores (including game species)	Positive	Low	100	Rabbit grazing

Site description:

Tiny pockets of potentially suitable habitat were searched on the sides of hummocks and in blow-outs in an area of low sandhills at this large machair site, but only one small population of *P. ralfsii* was found in short and open vegetation on compacted sand in a slightly flushed vegetated depression on the edge of a blow-out. One monitoring stop was recorded here.

Associated species recorded in the stop include *Festuca rubra*, *Koeleria macrantha*, *Holcus lanatus*, *Juncus acutiflorus*, *Carex arenaria*, *Bellis perennis*, *Centaureum erythraea*, *Leontodon saxatilis*, *Plantago coronopus*, *P. lanceolata*, *Ranunculus bulbosus*, *Sagina procumbens*, *Trifolium repens*, *Viola tricolor*, *Aneura pinguis*, *Brachythecium rutabulum*, *Bryum pseudotriquetrum*, *Cratoneuron filicinum*, *Didymodon fallax*, *Homalothecium lutescens* and *Trichostomum brachydontium*.

The vegetation is too tall and overgrown in the majority of the zone of the low sandhills for *P. ralfsii*. The site is grazed by cattle and sheep, but appears undergrazed as there was a low number of animals in a large area. An increase in grazing may be beneficial to *P. ralfsii* at this site. However, the species was never found in large numbers at the site and it has persisted here since its discovery in 1998. There is no reason to assume that there will not be a continuity of suitable habitat present at the site for the species to continue to colonise small areas of suitable habitat as long there is no cessation of grazing at the site. There should be no objection to an increase in grazing numbers at this site.

The area as far as the stream to the east/north-east of the site was searched unsuccessfully.

Management recommendations:

Maintain current grazing regime and increase if possible. Ensure no reduction in grazing levels.

Site Pr11 Keel Machair

001513 Keel Machair/Menaun Cliffs SAC

Summary site data:

Location (Irish Grid):	64512 304613	Discovery map:	22
Vice county:	West Mayo (H27)	Aerial photo no. (2005):	O1642-C
Extent of occurrence (ha):	1.07	Type of survey:	Full survey
Area of suitable habitat (m²):	6,413	No. of monitoring stops:	4
Population thalli estimate:	352,715	Percentage male thalli:	0.5%
Percentage female thalli:	0.5%	Percentage sporophytes:	8.1%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.02	Non-intensive sheep grazing	Positive	Medium	100	
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	26-50	
G02.01	Golf course	Neutral	Medium	1-25	
G01.03.02	Off-road motorized driving	Neutral	Medium	1-25	Tyre tracks present
K04.05	Damage by herbivores (including game species)	Positive	Low	100	Rabbit grazing

Site description:

This site occurs on a machair plain between a shingle bar above a beach and Keel Lough to the north and to the west of the river outflow from Keel Lough. *Petalophyllum ralfsii* was also found in an area of machair behind fixed dunes to the east of the machair plain. The species was also found along the edges of water tracks, and in damp hollows, on trackways and on the sides of slightly elevated hummocks on the machair. The species was recorded closer to the road along the north of the machair than during previous surveys undertaken as part of the Rare and Threatened Bryophyte Surveys.

The vegetation composition appeared somewhat more acidic in places than described previously during the Rare and Threatened Bryophytes surveys, particularly in areas searched nearer the coast.

Four monitoring stops were recorded on short vegetation (2–4 cm) on sandy humic soil 4–8 cm deep overlying pure sand. Associated species include *Festuca rubra*, *Carex panicea*, *Bellis perennis*, *Leontodon saxatilis*, *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Prunella vulgaris*, *Trifolium repens*, *Bryum*

pallens, *Calliergonella cuspidata*, *Campylium stellatum*, *Campyliadelphus chrysophyllus*, *Ditrichum gracile*, *Entodon concinnus* and *Selaginella selaginoides*.

The site is grazed heavily by sheep and also rabbits. There is a golf/pitch and putt course on the machair, which was deemed as having a neutral impact, and the area is popular with walkers. There is a caravan site adjacent to the site. Vehicle tracks were seen throughout the site which were deemed as having a neutral impact as vehicles driving over the machair help to compress the substrate and keep vegetation low, which can favour *P. ralfsii*, but too much on a continual basis can make the ground too compacted for the species.

Some dumping was noted in the area of fixed dunes to the east of the machair plain near the coast. This is outside the extent of occurrence of *P. ralfsii*, but dumping is a potential threat to the species at the site.

The *Near Threatened* fern *Ophioglossum azoricum* was recorded at this site in *P. ralfsii* habitat, but did not occur in any of the monitoring stops.

Management recommendations:

Maintain current grazing regime.

Site Pr12 Dooaghtry

001932 Mweelrea/Sheeffry/Erriff Complex SAC

Summary site data:

Location (Irish Grid):	75015 268849	Discovery map:	37
Vice county:	West Mayo (H27)	Aerial photo no. (2005):	O2385-D
Extent of occurrence (ha):	10.2	Type of survey:	Monitoring
Area of suitable habitat (m²):	58,563	No. of monitoring stops:	5
Population thalli estimate:	409,941	Percentage male thalli:	Indeterminate
Percentage female thalli:	13.8%	Percentage sporophytes:	3.4%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤80 cm depth)	Pass	
	Shrub cover (≤25%)	Pass	
	Grass cover (≤60%)	Pass	
	Cover of bare ground (≥5%)	Pass	
	Mean vegetation height (<9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.02	Non-intensive sheep grazing	Positive	High	100	
K04.05	Damage by herbivores (including game species)	Positive	Medium	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	51-75	
G01.03.02	Off-road motorized driving	Neutral	Medium	1-25	Tyre tracks present
K01.01	Erosion	Neutral	Low	1-25	
K02.01	Species composition change (succession)	Negative	Low	1-25	Natural succession

Site description:

Petalophyllum ralfsii was recorded here in previous surveys on a large machair plain, particularly around the edges of the flat machair plain. New colonies of the species were recorded in an area above the beach behind the dunes to the south-east of the main machair plain at the site. The extent of occurrence in this area was mapped. The machair at this site appears largely unchanged from the baseline survey.

Associated species recorded in the monitoring stops include *Carex panicea*, *C. arenaria*, *Festuca rubra*, *Koeleria macrantha*, *Luzula campestris*, *Bellis perennis*, *Cerastium fontanum*, *Erophila verna*, *Plantago coronopus*, *P. lanceolata*, *Sagina nodosa*, *Saxifraga tridactylites*, *Thymus polytrichus*, *Aneura pinguis*, *Ctenidium molluscum*, *Didymodon insulanus*, *Distichium inclinatum*, *Ditrichum gracile*, *Homalothecium lutescens*, *Scapaia aspera* and *Trichostomum brachydontium*.

The site is heavily grazed by sheep, and also rabbits, which is beneficial to *P. ralfsii* as it keeps the vegetation very short and open. Some erosion, possibly due to overgrazing on the machair, was noted.

This is regarded as a neutral impact as, despite being negative in the sense it may disturb thalli present, it creates new habitat that will eventually be recolonised.

Vehicle tracks were noted through parts of the site. This was deemed a neutral impact at this site as vehicles can compress the substrate which is beneficial to *P. ralfsii*, however, some tracks had broken up the ground surface. If this occurs on a continual basis vegetation won't establish. However, this only affected a very small proportion of the extent of occurrence and it may have been exacerbated by the particularly wet prevailing conditions in spring 2018.

Management recommendations:

Maintain current management regime.

Site Pr13 Omey Island Machair

001309 Omey Island Machair SAC

Summary site data:

Location (Irish Grid):	56103 255768	Discovery map:	37
Vice county:	West Galway (H16)	Aerial photo no. (2005):	O2654-D, O2723-B, O2724-A
Extent of occurrence (ha):	0.047	Type of survey:	Full survey
Area of suitable habitat (m²):	262	No. of monitoring stops:	4
Population thalli estimate:	6,026	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	2.2%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤80 cm depth)	Pass	
	Shrub cover (≤25%)	Pass	
	Grass cover (≤60%)	Pass	
	Cover of bare ground (≥5%)	Pass	
	Mean vegetation height (<9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Medium	100	
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	51-75	
G01.03.02	Off-road motorized driving	Positive	Medium	51-75	Tyre tracks present

Site description:

Petalophyllum ralfsii at this site occurs on the machair at the north-west of the island. Thalli were recorded on flushed machair slopes, in flat flushed areas of machair, on trackways and around rocky outcrops and there was much potentially suitable habitat present at the site.

Four monitoring stops were recorded on mostly humic sand. Depth of groundwater could not be recorded at two of the stops where bedrock was reached at 35 cm and 14 cm respectively. One stop was recorded on peaty calcareous sand in a flat wet basin that seasonally floods.

Associated species recorded in the monitoring stops include *Festuca rubra*, *Carex arenaria*, *C. flacca*, *Bellis perennis*, *Hypochaeris radicata*, *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Prunella vulgaris*, *Aneura pinguis*, *Bryum pseudotriquetrum*, *Calliergonella cuspidata*, *Ctenidium molluscum*, *Didymodon fallax*, *Fissidens dubius*, *Homalothecium lutescens*, *Moerckia flotoviana* and *Pellia endiviifolia*.

The site is grazed by cattle and rabbits. The species was recorded along trackways in short vegetation and continued vehicle usage, at the level observed, at the site is beneficial.

Management recommendations:

Maintain current management regime.

Site Pr14a Mannin More
002074 Slyne Head Peninsula SAC

Summary site data:

Location (Irish Grid):	60608 246226	Discovery map:	44
Vice county:	West Galway (H16)	Aerial photo no. (2005):	O2930-D
Extent of occurrence (ha):	1.08	Type of survey:	Full survey
Area of suitable habitat (m²):	4,104	No. of monitoring stops:	4
Population thalli estimate:	201,096	Percentage male thalli:	Indeterminate
Percentage female thalli:	1%	Percentage sporophytes:	0.5%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
A04.02.02	Non-intensive sheep grazing	Positive	High	100	
A04.02	Non-intensive grazing	Positive	Low	100	Donkeys
K04.05	Damage by herbivores (including game species)	Positive	Low	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	51-75	
G01.03.02	Off-road motorized driving	Positive	Low	26-50	Tyre tracks present

Site description:

This site occurs in a large area of machair formed along the back of a series of long sandy beaches. *Petalophyllum ralfsii* occurs in two main areas in this site. The first recorded extent of occurrence was in a large depression in the south of the machair of which c. 30% is suitable habitat. This area is grazed by sheep and vehicle tracks were present along the southern edge of the extent of occurrence in this area. *P. ralfsii* occurs mainly on tracks and areas of intermediate wetness. In the north of the site, *P. ralfsii* was recorded on tightly grazed machair.

Much more potentially suitable habitat was present and searched, but was found to be very dry when the site was visited in April 2017. It could be expected that more thalli would be found in other years with wetter prevailing conditions.

Four monitoring stops were recorded on closely grazed vegetation (mean vegetation height of 2 cm) on humic sandy soil, c. 1–5 cm deep, overlying pure sand. Associated species recorded include *Agrostis stolonifera*, *Festuca rubra*, *Carex arenaria*, *C. flacca*, *Bellis perennis*, *Euphrasia officinalis* agg., *Hypochaeris*

radicata, *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Sagina procumbens*, *Calliergonella cuspidata*, *Campyliadelphus chrysophyllus*, *Ctenidium molluscum*, *Ditrichum gracile*, *Homalothecium lutescens* and *Rhytidiadelphus squarrosus*.

The site is grazed by sheep, as well as donkeys. Cattle dung was also present on the site, but no cattle were observed. Vehicle tracks were present through the site, some ground was ripped up near the entrance to the site, but overall vehicle use at this site is not damaging, and old trackways provide suitable habitat in parts of the site.

Management recommendations:

Maintain current management regime.

Site Pr14b Truska Machair
002074 Slyne Head Peninsula SAC

Summary site data:

Location (Irish Grid):	58357 245903	Discovery map:	44
Vice county:	West Galway (H16)	Aerial photo no. (2005):	O2929-A/B/D
Extent of occurrence (ha):	5.2	Type of survey:	Monitoring
Area of suitable habitat (m²):	30,211	No. of monitoring stops:	5
Population thalli estimate:	392,730	Percentage male thalli:	Indeterminate
Percentage female thalli:	4.5%	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
A04.02.02	Non-intensive sheep grazing	Positive	High	100	
K04.05	Damage by herbivores (including game species)	Positive	Low	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Medium	1-25	
G01.03.02	Off-road motorized driving	Positive	Medium	1-25	Tyre tracks present
K02.01	Species composition change (succession)	Negative	Medium	1-25	Natural succession

Site description:

Truska Machair is a large machair site on the north-west of Slyne Head Peninsula. Two main areas of extent of occurrence are found at this site. The largest occurs on the main Truska machair plain that is bordered to the north and north-west by a sand ridge. This area is seasonally flooded in parts, receives wind-blown sand from the ridge and is grazed by cattle and sheep. The second largest extent occurs in a damp and seasonally flooded area to the south-west of the largest extent.

The most obvious change at this site from the baseline survey was some succession in areas furthest from the coast in the two main areas of extent at this site, where conditions appeared less open and more densely vegetated than in previous visits. This is due to natural succession in these areas.

The extent of occurrence recorded during the 2016–2018 survey was lower than that recorded previously. Some locations recorded during the NPWS Rare and Threatened Bryophyte surveys that outlie the two main extent of occurrence polygons recorded by Campbell (2013) were searched, but the

species was not found and conditions did not appear particularly suitable in these areas, either being overgrown by vegetation or too dry.

A lower area of suitable habitat was estimated in the 2016–2018 survey than during the baseline survey and, while the site is not as heavily grazed as the other two large machair sites in the Galway/Mayo area, Pr07 Garter Hill and Pr12 Dooaghtry, the mean vegetation height recorded in the monitoring stops during the 2016–2018 survey was the same as recorded during the baseline survey (3.6 cm).

Associated species recorded include *Festuca rubra*, *Carex arenaria*, *C. flacca*, *Juncus acutiflorus*, *Luzula campestris*, *Bellis perennis*, *Euphrasia officinalis* agg., *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Prunella vulgaris*, *Sagina procumbens*, *Trifolium repens*, *Amblyodon dealbatus*, *Aneura pinguis*, *Bryum pseudotriquetrum*, *Calliergonella cuspidata*, *Cratoneuron filicinum*, *Didymodon fallax*, *Homalothecium lutescens* and *Syntrichia ruralis* subsp. *ruraliformis*.

The site is grazed by sheep and rabbits, with some evidence of cattle grazing (dung) also present. The site is used by walkers and off-road vehicles, but not at a level that is damaging and suitable habitat for *Petalophyllum ralfsii* occurs in the trackways and wheel ruts at the site.

Management recommendations:

Maintain current management regime.

Site Pr14c Doon Hill/West of Aillebrack
002074 Slyne Head Peninsula SAC

Summary site data:

Location (Irish Grid):	58179 242814	Discovery map:	44
Vice county:	West Galway (H16)	Aerial photo no. (2005):	O2999-A/B
Extent of occurrence (ha):	2.2	Type of survey:	Full survey
Area of suitable habitat (m²):	9,763	No. of monitoring stops:	3
Population thalli estimate:	253,838	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Medium	100	
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	26-50	
G01.08	Other outdoor sports and leisure activities	Neutral	Low	1-25	Ballyconneely races
G01.03.02	Off-road motorized driving	Neutral	Medium	51-75	Tyre tracks present

Site description:

Aillebrack machair occurs between Aillebrack Lough to the north and the beach to the south-west, east of the Connemara Golf Course on Slyne Head Peninsula. *Petalophyllum ralfsii* occurs mostly along old trackways and wheel ruts through Aillebrack machair and on undulating machair plain in places.

Three monitoring stops were recorded at this site in short vegetation (mean vegetation height of 1.3 cm) on humic sandy soil c. 3–6 cm deep overlying pure sand. Associated species recorded include *Festuca rubra*, *Carex flacca*, *C. caryophyllea*, *Bellis perennis*, *Plantago lanceolata*, *Prunella vulgaris*, *Scorzoneroideis autumnalis*, *Calliergonella cuspidata*, *Ctenidium molluscum*, *Ditrichum gracile* and *Homalothecium lutescens*.

The site is grazed by cattle on a year-round basis and is also grazed by rabbits. The Ballyconneely Races occur every year in August at Aillebrack, although mostly outside the extent of occurrence mapped during the 2016–2018 survey. The race event has been held over a great number of years in the locality and does not seem to be negatively affecting the habitat for *P. ralfsii* overall.

Vehicle usage was deemed to be a neutral impact because, while it is beneficial in compacting the ground and creating suitable habitat for *P. ralfsii* (one stop was recorded on revegetating tractor wheel ruts), small areas of the machair were cut up by tracks which would be damaging to the habitat if occurring on a continual basis.

Management recommendations:

Maintain current management regime.

Site Pr15 Murvey Machair

002129 Murvey Machair SAC

Summary site data:

Location (Irish Grid):	66150 239021	Discovery map:	44
Vice county:	West Galway (H16)	Aerial photo no. (2005):	O3069-D
Extent of occurrence (ha):	0.88	Type of survey:	Full survey
Area of suitable habitat (m²):	2,646	No. of monitoring stops:	4
Population thalli estimate:	39,690	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.02	Non-intensive sheep grazing	Positive	High	100	
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Low	26-50	
G01.03.02	Off-road motorized driving	Positive	Medium	26-50	Tyre tracks present

Site description:

Murvey machair occurs south of Lough Namanawaun. *Petalophyllum ralfsii* occurs at this site on flushed machair, particularly near rocky outcrops. The site is very exposed with large amounts of wind-blown sand present. Waterlogging occurred in some parts of the machair when visited in early April 2016. Some tufa formation was noted in particularly flushed areas of the machair.

Four monitoring stops were recorded on short open vegetation (mean vegetation height of 1.4 cm) on humic sand. Bedrock was reached at 14 cm and 29 cm at two stops and the groundwater table was at 19 cm and 26 cm below ground surface at the other two stops. Associated species recorded include *Festuca rubra*, *Carex flacca*, *Bellis perennis*, *Leontodon saxatilis*, *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *P. maritima*, *Prunella vulgaris*, *Thymus polytrichus*, *Aneura pinguis*, *Bryum pallens*, *Ctenidium molluscum*, *Homalothecium lutescens* and *Syntrichia ruralis* subsp. *ruraliformis*.

The site is very closely grazed by sheep, and is also grazed by rabbits and hares. Vehicle tracks were observed in places, but this was not seen to be damaging and could benefit *P. ralfsii* by compressing the sand making colonisation possible. Walkers were also observed on the site. Parts of the machair are eroded, but this is outside the extent of occurrence of *P. ralfsii*.

Management recommendations:

Maintain current grazing regime.

Site Pr16 Fanore

000020 Black Head-Poulsallagh Complex SAC

Summary site data:

Location (Irish Grid):	113822 208798	Discovery map:	51
Vice county:	Clare (H09)	Aerial photo no. (2005):	O3678-C
Extent of occurrence (ha):	0.006	Type of survey:	Monitoring
Area of suitable habitat (m²):	47	No. of monitoring stops:	3
Population thalli estimate:	6,157	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤80 cm depth)	Pass	
	Shrub cover (≤25%)	Pass	
	Grass cover (≤60%)	Pass	
	Cover of bare ground (≥5%)	Pass	
	Mean vegetation height (<9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A08	Fertilisation	Negative	Low	<1	Dog faeces
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Medium	100	Walkers on track
G01.03.02	Off-road motorized driving	Positive	Low	76-99	Tyre tracks present

Site description:

Petalophyllum ralfsii occurs at this site along a trampled pathway in a flat depression strewn with large limestone boulders between sand dunes. There was no discernible change from the baseline survey at this site. In all monitoring stops, the thalli were mostly young/emerging; a small number of older, larger more weather-beaten thalli were also present. Monitoring stop 2 had the highest number of thalli (357 recorded) of the three stops, and this was positioned in a part of the track that was slightly lower and wetter than the other two stops.

Associated species recorded in the stops include *Festuca rubra*, *Koeleria macrantha*, *Carex flacca*, *Bellis perennis*, *Cuscuta epithimum*, *Hypochaeris radicata*, *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Prunella vulgaris*, *Sagina procumbens*, *Taraxacum officinale* agg., *Aneura pinguis*, *Bryum pallens*, *Bryum pseudotriquetrum*, *Calliargonella cuspidata*, *Campyliadelphus chrysophyllus*, *Ctenidium molluscum*, *Ditrichum gracile*, *Homalothecium lutescens*, *Hypnum lacunosum* and *Syntrichia ruralis* subsp. *ruraliformis*

The pathway is trampled by walkers/dog walkers, mostly from a nearby caravan park. Dog faeces was observed along the track. The site is grazed by rabbits. Tyre tracks were observed to the east of the pathway and this appears to be the route usually taken by motorised vehicles (most likely

scramblers/bikes). However, tyre tracks were also seen through the pathway, which were not damaging and appeared to occur at a very low intensity.

The Near Threatened moss *Pleurochaete squarrosa* occurs at this site and was recorded in two monitoring stops.

Management recommendations:

Maintain current management regime.

Site Pr17a SW of Lough Naparka
002070 Tralee Bay and Magharees Peninsula, West to Cloghane SAC

Summary site data:

Location (Irish Grid):	61603 116797	Discovery map:	71
Vice county:	South Kerry (H01)	Aerial photo no. (2005):	O5517-D
Extent of occurrence (ha):	-	Type of survey:	(Monitoring)
Area of suitable habitat (m²):	-	No. of monitoring stops:	1
Population thalli estimate:	0	Percentage male thalli:	0
Percentage female thalli:	0	Percentage sporophytes:	0

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	No	Unfavourable – Inadequate
	Thalli not present & <i>Habitat for the Species</i> Assessment is	Yes	
	Unfavourable - Inadequate		
Habitat for the Species:	No. of attributes passed	4	Unfavourable – Inadequate
	Hydrology (≤80 cm depth)	Pass	
	Shrub cover (≤25%)	Pass	
	Grass cover (≤60%)	Pass	
	Cover of bare ground (≥5%)	Fail	
	Mean vegetation height (<9 cm)	Pass	
Future prospects:			Unfavourable – Inadequate
OVERALL ASSESSMENT:			UNFAVOURABLE - INADEQUATE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
K04.05	Damage by herbivores (including game species)	Positive	Low	100	Rabbit grazing
K02.01	Species composition change (succession)	Negative	Low	76-99	

Site description:

Petalophyllum ralfsii was discovered at this site by Dr Neil Lockhart in 1998 during the NPWS Rare and Threatened Bryophyte Surveys. Five thalli were recorded on the sloping side of a low (c. 50 cm) sandy ridge at the north-east end of a flooded dune slack, above a zone of *Salix repens*, c. 1 m from open water, c. 35 cm above the water table, in a tightly grazed mossy turf with an open sunny aspect. It was noted that overstocking by cattle had made nearby wet slacks unsuitable for *P. ralfsii*. A relevé was recorded at this location in 1998.

The site was revisited as part of the NPWS Rare and Threatened Bryophyte Surveys in 2003 and 2006, but the species was not refound.

During the 2016–2018 survey, the site was visited in April 2017 and the species was not found at the site, but as prevailing conditions had been very dry, it was decided to revisit the site the following spring. When visited in April 2018, the site was very wet and the slack was filled with standing water. A few (10-15) square metres of potentially suitable habitat, i.e. open areas with low vegetation height

and cover, around the edges of the slack were searched, but no thalli were found. The site was revisited in May 2018 and again, no thalli were found and a monitoring stop was recorded at the point where the relevé had been recorded in 1998 in order to quantify the existing unsuitability of the area. As the species was not found, a full survey could not be carried out and the monitoring stop recorded the assessment attributes only.

The stop failed on cover of bare ground as the area around where the relevé was recorded is now densely vegetated (although potentially suitable open habitat remains elsewhere around the slack). The mean vegetation height was 5 cm, which is higher than the 2 cm herb/grass height recorded by Dr Lockhart in 1998. Grass cover of 35% comprised *Agrostis stolonifera* and *Festuca rubra*. Other species recorded include *Bellis perennis*, *Cerastium fontanum*, *Hydrocotyle vulgaris*, *Lotus corniculatus*, *Lysimachia nummularia*, *Potentilla anserina*, *Prunella vulgaris*, *Ranunculus bulbosus*, *Trifolium repens*, *Brachythecium rutabulum* and *Calliergonella cuspidata*. The site appears to be sufficiently wet for *P. ralfsii* with the water table c. 10 cm below the ground surface.

The site is still grazed by cattle, and rabbits. It is recommended that the management is changed to sheep grazing to create a tighter sward and improve conditions for *P. ralfsii* at this site.

Management recommendations:

Change from cattle to sheep grazing.

Site Pr17b Magherabeg

002070 Tralee Bay and Magharees Peninsula, West to Cloghane SAC

Summary site data:

Location (Irish Grid):	61245 115730	Discovery map:	71
Vice county:	South Kerry (H01)	Aerial photo no. (2005):	O5517-C
Extent of occurrence (ha):	0.422	Type of survey:	Monitoring
Area of suitable habitat (m²):	211	No. of monitoring stops:	5
Population thalli estimate:	5,486	Percentage male thalli:	Indeterminate
Percentage female thalli:	20.2%	Percentage sporophytes:	7.8%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Medium	100	
G01.03.02	Off-road motorized driving	Neutral	Medium	1-25	Tractors/scrambling
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Medium	26-50	Walkers

Site description:

This site occurs in a dune slack with a dune ridge to the north-east. *Petalophyllum ralfsii* occurs here on disturbed hillocks and eroded sand mounds in the slack. Not much change has occurred at this site since the baseline survey. There appears to be a continuity of suitable habitat at the site; some areas appeared more vegetated than during the baseline survey, but sufficient areas of bare ground remain.

Associated species recorded in the monitoring stops include *Salix repens*, *Festuca rubra*, *Carex arenaria*, *C. flacca*, *Bellis perennis*, *Centaureum erythraea*, *Euphrasia officinalis* agg., *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Prunella vulgaris*, *Ranunculus bulbosus*, *Scorzoneroideis autumnalis*, *Thymus polytrichus*, *Trifolium repens*, *Aneura pinguis*, *Bryum pallens*, *Bryum pseudotriquetrum*, *Cratoneuron filicinum*, *Didymodon fallax*, *Homalothecium lutescens*, *Lophocolea bidentata* and *Pseudoscleropodium purum*.

The site is grazed by cattle. There was evidence of quad-bike scrambling in the slack, but on flatter ground and it does not appear to be affecting the hummocks where *P. ralfsii* occurs. This activity was also noted when the site was visited during the baseline survey. The scrambling could potentially create new habitat for *P. ralfsii*, but conditions are possibly too wet on the flatter ground in the slack for *P. ralfsii* overall. Walkers were also seen at the site. *Hippophae rhamnoides* was also observed as prevalent in parts of the nearby dune. Encroachment of this invasive shrub is a possible threat. However, the slack is probably too wet for *H. rhamnoides* to invade inside the extent of occurrence at the site.

Management recommendations:

Maintain current grazing regime.

Site Pr17c Kilshannig

002070 Tralee Bay and Magharees Peninsula, West to Cloghane SAC

Summary site data:

Location (Irish Grid):	62028 117158	Discovery map:	71
Vice county:	South Kerry (H01)	Aerial photo no. (2005):	O5517-B
Extent of occurrence (ha):	-	Type of survey:	(Monitoring)
Area of suitable habitat (m²):	-	No. of monitoring stops:	1
Population thalli estimate:	0	Percentage male thalli:	0
Percentage female thalli:	0	Percentage sporophytes:	0

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	No	Unfavourable - Inadequate
	Thalli not present & <i>Habitat for the Species</i> Assessment is	Yes	
	Unfavourable - Inadequate		
Habitat for the Species:	No. of attributes passed	2	Unfavourable - Inadequate
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Fail	
	Cover of bare ground ($\geq 5\%$)	Fail	
	Mean vegetation height (< 9 cm)	Fail	
Future prospects:			Unfavourable - Inadequate
OVERALL ASSESSMENT:			UNFAVOURABLE - INADEQUATE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Negative	High	100	
G05.01	Trampling, overuse	Negative	High	1-25	Poaching by cattle
K02.01	Species composition change (succession)	Negative	Low	76-99	

Site description:

Petalophyllum ralfsii was recorded at this site by Nick Hodgetts during the Rare and Threatened Bryophyte surveys in 2003. Three thalli were recorded on the edge of a slack in sand/humus soil, just above a cattle track and a zone of *Salix repens*. At that time, the population was noted as being threatened by poaching, eutrophication and grazing from the high stocking density of cattle.

During the 2016–2018 survey, the site was visited in April 2017 and the species was not found at the site, but as prevailing conditions had been very dry, it was decided to revisit the site the following spring. When visited in April 2018, parts of the slack were filled with standing water. A very small area (2–5 m²) of potentially suitable habitat, i.e. open areas with low vegetation height and cover, was searched above the edges of the slack, but no thalli were found. The site was revisited in May 2018 and again, no thalli were found and a monitoring stop was recorded at the point where a photograph had been taken where *P. ralfsii* was recorded in 2003 in order to quantify the unsuitability of the area at present. As the species was not found, a full survey could not be carried out and the monitoring stop recorded the assessment attributes only.

The stop failed to meet the targets for grass cover, cover of bare ground and mean vegetation height. The cover of bare ground was 0% and mean vegetation height was 10 cm. Grass cover of 70% comprised *Festuca rubra* and *Holcus lanatus*. Other species recorded include *Carex arenaria*, *Bellis perennis*, *Lotus corniculatus*, *Plantago lanceolata*, *Prunella vulgaris*, *Ranunculus repens*, *Senecio jacobea*, *Trifolium repens*, *Brachythecium rutabulum*, *Calliergonella cuspidata*, *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum*.

The site is grazed by cattle and the track above which the stop was recorded was very poached. The site may be eutrophicated also.

Management recommendations:

It is recommended that the management is changed to sheep grazing to create a tighter sward and improve conditions for *P. ralfsii* at this site.

Site Pr18a Inch Spit

000343 Castlemaine Harbour SAC

Summary site data:

Location (Irish Grid):	67351 97048	Discovery map:	78
Vice county:	South Kerry (H01)	Aerial photo no. (2005):	O5930-D; O5986-B
Extent of occurrence (ha):	1.1	Type of survey:	Monitoring
Area of suitable habitat (m²):	6,246	No. of monitoring stops:	5
Population thalli estimate:	87,444	Percentage male thalli:	Indeterminate
Percentage female thalli:	8.3%	Percentage sporophytes:	4.2%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Positive	Low	100	
A04.02.02	Non-intensive sheep grazing	Positive	Medium	100	
K04.05	Damage by herbivores (including game species)	Positive	High	100	Rabbit grazing
G01.03.02	Off-road motorized driving	Neutral	Medium	0	Scrambling outside extent of occurrence

Site description:

The sand spit at Inch, Co. Kerry is the largest and possibly one of the best remaining intact, highly dynamic and naturally functioning dune systems in the country which displays an excellent representation of succession from strandline, foredunes, mobile yellow dunes, fixed grey dunes, dune grassland through to dune slacks. *Petalophyllum ralfsii* occurs in dune slacks towards the south of the spit. No discernible change had occurred since the baseline survey in the two slacks with *P. ralfsii* nearest the end of the spit. In a third slack further from the tip of the spit, where one thallus had previously been found during the baseline survey, the sea appears to occasionally inundate the area making conditions unsuitable for *P. ralfsii*. The thallus was probably just a transient occurrence when recorded during the baseline survey. New colonies were found in another area near the baseline extent of occurrence.

Associated species include *Salix repens*, *Carex arenaria*, *C. flacca*, *Poa annua*, *Euphrasia officinalis* agg., *Hydrocotyle vulgaris*, *Lotus corniculatus*, *Prunella vulgaris*, *Sagina procumbens*, *Scorzoneroideis autumnalis*, *Aneura pinguis*, *Bryum pallens*, *Calliergonella cuspidata*, *Didymodon insulanus*, *Drepanocladus polygamus*, *Homalothecium lutescens*, *Rhytidiadelphus triquetrus* and *Riccardia multifida*.

The site is grazed by sheep, cattle and rabbits. There was evidence of quad-biking on some dunes, although not in the slacks surveyed.

Management recommendations:

Maintain current management regime.

Site Pr19 West of Inny Ferry

000335 Ballinskelligs Bay and Inny Estuary SAC

Summary site data:

Location (Irish Grid):	47160 68187	Discovery map:	83
Vice county:	South Kerry (H01)	Aerial photo no. (2005):	47160 68187
Extent of occurrence (ha):	-	Type of survey:	(Monitoring)
Area of suitable habitat (m ²):	-	No. of monitoring stops:	2
Population thalli estimate:	0	Percentage male thalli:	0
Percentage female thalli:	0	Percentage sporophytes:	0

Assessment data:

Parameter	Attribute	Result	Assessment
<i>Population:</i>	Thalli present	No	Unfavourable - Inadequate
	Thalli not present & <i>Habitat for the Species</i> Assessment is	Yes	
	Unfavourable - Bad		
<i>Habitat for the Species:</i>	No. of attributes passed	3	Unfavourable - Inadequate
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Fail	
	Cover of bare ground ($\geq 5\%$)	Fail	
	Mean vegetation height (< 9 cm)	Pass	
<i>Future prospects:</i>			Unfavourable - Inadequate
OVERALL ASSESSMENT:			UNFAVOURABLE - INADEQUATE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
A04.02.01	Non-intensive cattle grazing	Neutral	Low	100	
K02.01	Species composition change (succession)	Negative	Low	76-99	

Site description:

The site at 'West of Inny Ferry' near Waterville, Co. Kerry was the first record for *P. ralfsii* in Kerry found by R. Scully who gave the location as 'about 1 mile west of the ferry on the north side' (Scully, 1890). The site was visited in 1998 by Dr Neil Lockhart during the Rare and Threatened Bryophyte surveys, who found 30–50 thalli in an area of 1 m x 2 m and a single rosette about 20 m away on tightly grazed turf on compact sandy soil halfway up a sandy ridge that surrounded a flooded depression. It was noted that potential habitat at the site was limited at that time. The site was visited during the baseline survey in 2009, 2010 and 2011, but no thalli were recorded in the area described by Dr Lockhart or in any surrounding areas, despite extensive searches.

The site described by Dr Lockhart was searched, as was potentially suitable habitat in surrounding areas during the 2016–2018 survey, but no thalli were recorded. The site had not changed since the baseline survey. There were some areas of bare ground in patches on some ridges at the location, but they were very dry.

Two monitoring plots were recorded during the 2016–2018 survey, located where relevé plots had been recorded in 1998 by Dr Lockhart. As the species was not found, a full survey could not be carried out

and the monitoring stops recorded the assessment attributes only. The *Habitat for the Species* assessment failed on the grass cover and cover of bare ground attributes. Grass cover comprised *Elytrigia repens*, *Holcus lanatus*, *Anthoxanthum odoratum* and also *Agrostis stolonifera*. Other species recorded include *Carex flacca*, *Juncus acutiflorus*, *Luzula campestris*, *Cerastium fontanum*, *Lotus corniculatus*, *Plantago lanceolata*, *Trifolium repens*, *Brachythecium albicans*, *B. rutabulum*, *Plagiomnium undulatum*, *Rhytidiadelphus squarrosus* and *Pseudoscleropodium purum*.

In 1998, Dr Lockhart reported the location as heavily grazed and poached by cattle. When visited during the baseline survey and during the 2016–2018 survey, the site appeared to be grazed inappropriately for *P. ralfsii*, despite being still grazed by cattle.

Agricultural intensification is also a potential threat at this site.

Management recommendations:

A change from cattle grazing to sheep grazing at this site may result in a lower sward and more open ground for *P. ralfsii*.

Site Pr20 North Bull

000206 North Dublin Bay SAC

Summary site data:

Location (Irish Grid):	324626 237932	Discovery map:	50
Vice county:	Dublin (H21)	Aerial photo no. (2005):	O3134-C; O3200-A
Extent of occurrence (ha):	0.19	Type of survey:	Monitoring
Area of suitable habitat (m²):	95	No. of monitoring stops:	3
Population thalli estimate:	665	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	0%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
<i>Population:</i>	Thalli present	Yes	Favourable
<i>Habitat for the Species:</i>	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
<i>Future prospects:</i>			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Medium	100	
K04.05	Damage by herbivores (including game species)	Positive	Medium	100	Rabbit grazing

Site description:

Petalophyllum ralfsii occurs along a trampled track c. 1–2 m wide along the seaward side of the Alder Marsh, a dune slack among the fixed dunes on the north end of Bull Island. There was no discernible change at this site since the baseline survey. Standing water was observed along parts of the track when visited in March 2016.

Associated species recorded include *Agrostis stolonifera*, *Festuca rubra*, *Cynosurus cristatus*, *Carex panicea*, *Juncus articulatus*, *Bellis perennis*, *Leontodon saxatilis*, *Lotus corniculatus*, *Plantago lanceolata*, *Prunella vulgaris*, *Succisa pratensis*, *Trifolium repens*, *Aneura pinguis*, *Bryum pseudotriquetrum*, *Calliergonella cuspidata* and *Ctenidium molluscum*.

The population here is maintained by trampling by walkers/joggers and by rabbit grazing which keep the soil compact and the vegetation low.

Localised nutrient enrichment from dog droppings, as the site is popular with dog-walkers, is a potential threat. The island overlies a freshwater aquifer and lowering of the groundwater table is another potential threat to the *P. ralfsii* population and conditions in the dune slack in general.

Management recommendations:

Maintain current management regime.

Site Pr21 Barley Cove

001040 Barley Cover to Ballyrisode Point SAC

Summary site data:

Location (Irish Grid):	76981 25908	Discovery map:	88
Vice county:	West Cork (H3)	Aerial photo no. (2005):	O6793-C
Extent of occurrence (ha):	0.19	Type of survey:	Full survey
Area of suitable habitat (m²):	436	No. of monitoring stops:	3
Population thalli estimate:	24,416	Percentage male thalli:	Indeterminate
Percentage female thalli:	Indeterminate	Percentage sporophytes:	1.2%

Assessment data:

<i>Parameter</i>	<i>Attribute</i>	<i>Result</i>	<i>Assessment</i>
Population:	Thalli present	Yes	Favourable
Habitat for the Species:	No. of attributes passed	5	Favourable
	Hydrology (≤ 80 cm depth)	Pass	
	Shrub cover ($\leq 25\%$)	Pass	
	Grass cover ($\leq 60\%$)	Pass	
	Cover of bare ground ($\geq 5\%$)	Pass	
	Mean vegetation height (< 9 cm)	Pass	
Future prospects:			Favourable
OVERALL ASSESSMENT:			FAVOURABLE

Impacts and Activities:

Code	Description	Influence	Intensity	%affected	Notes
G01.02	Walking, horse-riding and non-motorised vehicles	Positive	Medium	51-75	Walkers
G01.03.02	Off-road motorized driving	Neutral	Low	26-50	
K04.05	Damage by herbivores (including game species)	Neutral	Medium	100	Rabbit grazing

Site description:

Petalophyllum ralfsii occurs at this site in two main extent of occurrence polygons. The first extent occurs along a trackway, c. 1–3 m, wide, through the back of fixed dune habitat. The second extent occurs in a dune slack to the south of the trackway.

Three monitoring stops were recorded, one on the trackway, which yielded a total of 116 thalli, and two in the slack. The substrate was shallow humic sandy soil, 1.5–3 cm deep, overlying pure sand. Associated species recorded in the stops include *Festuca rubra*, *Koeleria macrantha*, *Carex flacca*, *C. panicea*, *Bellis perennis*, *Lotus corniculatus*, *Plantago coronopus*, *P. lanceolata*, *Prunella vulgaris*, *Scorzoneroides autumnalis*, *Thymus polytrichus*, *Aneura pinguis*, *Cratoneuron filicinum*, *Didymodon fallax*, *Homalothecium lutescens*, *Hypnum lacunosum* and *Trichostomum brachydontium*.

The habitat is kept open by trampling, rabbit grazing and inundation, as no livestock grazing occurs at this site. Some quad-bike scrambling was noted in the slack which was cutting up the surface, but this activity was in a very small area of the slack and the impact of off-road driving is deemed to be neutral overall as the trackway is maintained by vehicle use, as well as by walkers.

The *Vulnerable* sand dune grass *Mibora minima* was recorded this site.

Management recommendations:

Maintain current management regime.

