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Monitoring and assessment of Killarney Fern (*Vandenboschia speciosa* (Willd.) G. Kunkel) in Ireland, 2019–2024

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Front cover photograph: Killarney Fern sporophyte colony *Vandenboschia speciosa*, Co. Waterford, Emer Ní Dhúill



Monitoring and assessment of Killarney Fern (*Vandenboschia speciosa* (Willd.) G. Kunkel) in Ireland, 2019–2024

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Executive Summary

This Irish Wildlife Manual presents details from the project 'Baseline and monitoring surveys of selected populations of *Vandenboschia speciosa* in Ireland, 2021–2024' to assess the conservation status of this EU Habitats Directive Annex II and Annex IV species *Vandenboschia speciosa* (Wiild.) G.Kunkel. Surveys were conducted between 2021 and 2024.

V. speciosa is a member of the Filmy Fern family (Hymenophyllaceae) and is the only European representative of the genus *Vandenboschia*. *V. speciosa* is most abundant in the Azores, outside of which it is most frequently found in Ireland and Britain.

V. speciosa differs from 'typical' ferns in that the sporophyte and gametophyte generations can live independently of each other by reproducing vegetatively, the gametophyte by means of gemmae, which are asexual propagules, and the sporophyte by means of rhizome spread. The ability of the gametophyte generation to live independently and reproduce by means of gemmae is considered rare in homosporous ferns (ferns that produce spores of one kind only) and is considered unique among European ferns. Whilst the sporophyte has been known from Ireland since 1804, the gametophyte was first recorded in the wild in Ireland as recently as 1992. The reported rare occurrence of sporophytic recruitment in conjunction with the persistence of both generations of *V. speciosa* often occurring independently has led to the conclusion that there has been a breakdown in the link in the life cycle between the sporophyte and gametophyte generations.

V. speciosa is restricted to damp, shady and humid habitats and is extremely sensitive to desiccation. In Ireland, when the sporophyte and gametophyte generations occur together, they occupy similar habitats in dripping caves, cliffs, crevices and gullies by waterfalls, crevices in woodland, and occasionally the floor of damp woodland; all deeply shaded humid habitats. Sporophyte colonies, however, are more limited in their distribution in Ireland than gametophyte colonies. Niches that the gametophyte can occupy are not always suitable for the growth of sporophytes, *i.e.* shallow crevices in otherwise open habitats that provide adequate shade for gametophytes, but not for the larger sporophytes.

The current known extant population of *V. speciosa* in the Republic of Ireland numbers 136 populations comprising 501 colonies, an increase from 86 populations comprising 290 colonies recorded in the last reporting period. The additional 50 populations represent an increase of 58% in the national number of population records for *V. speciosa*. This is considered a result of targeted surveying, improved knowledge, and more accurate data.

A survey of 49 *V. speciosa* populations was conducted between 2021–2024. The outputs of the survey fed into Ireland's 2025 EU Habitats Directive Article 17 reporting submission. The conservation status of this Annex II species was assessed under four parameters: (1) *Range*, (2) *Population*, (3) *Habitat for the species* and (4) *Future prospects*. Each parameter can receive an assessment of Favourable, Unfavourable-Inadequate or Unfavourable-Bad. The individual parameter assessments were then combined to give an overall national assessment of conservation status for the species.

This assessment resulted in 43 populations receiving a Favourable conservation assessment, with the remaining six populations receiving an Unfavourable-Inadequate assessment. This outcome was due to significant impacting activities recorded at those six populations, *e.g.* invasive non-native species, problematic native species, loss of canopy cover and bank slippage. These impacting activities were considered to be local issues and are not currently regarded as a threat at the national level. The overall Conservation Status for *V. speciosa* in Ireland was assessed as Favourable. However, in woodland locations where *V. speciosa* occurs, it is likely that climate change is increasing the frequency of treefall.

The increase in records for sporophytes emerging from gametophytes and maturing-juvenile sporophytes should continue to be monitored. Little is known of the survival rate of these

juvenile sporophytes and maturing-juvenile sporophytes. Continued monitoring will provide valuable information on their survival rates, and it will also provide an opportunity to better understand the trigger for their emergence and continued development, which may, at least in part, be due to climatic factors.

Since the last reporting period, pilot conservation measures were implemented at two sites in Co. Cork where *V. speciosa* occurs. It is recommended that these pilot conservation measures to control invasive alien species and problematic native species be monitored to determine if these measures are having a positive or neutral impact, and if they may be of benefit to other *V. speciosa* populations where invasive alien species and problematic native species have been identified as potentially negatively impacting the habitat. Conservation measures success will be evident over the long term (over the next 50–100 years). It is important that steps are taken now to restore the habitats where *V. speciosa* occurs, as although *Prunus laurocerasus* and *Rhododendron ponticum* provide essential canopy cover and shading at present, their continued presence at these locations is significantly impacting the broader habitat and will likely negatively impact *V. speciosa* colonies over time due to impacts such as bank slippage and excessive shading. Therefore, a wider view in terms of temporal and spatial scale should be taken to determine conservation requirements and priorities.

With the increase in extreme weather events, treefall may become a major impact for many populations in the future if essential canopy cover is lost or if falling trees directly damage colonies.

Because of the specific nature of its habitat and its specialised ecology, and as both generations of *V. speciosa* are very slow-growing, the species is potentially threatened by a wide variety of activities which are detailed in the report. Monitoring, management and protection of sites and populations is thus of prime importance for the maintenance of the conservation status of the species, especially with the increase in recording of juvenile sporophytes and maturing-juvenile sporophytes.

The report concludes with recommendations, a list of relevant literature and appendices.

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We are grateful to Donncha Ó Catháin for providing details of new *Vandenboschia speciosa* records for Co. Clare.

We wish to thank Dr Fred Rumsey of the Natural History Museum, London for forwarding information on *Vandenboschia speciosa* populations collected by himself and other botanists, and for permission to publish his drawing of the life cycle of *Vandenboschia speciosa* (Figure 1).

We are grateful to Dr James Merryweather who kindly gave permission to use his microscope images of gametophytes to aid identification in the field of this cryptic phase in the life cycle of *Vandenboschia speciosa*.

1 Introduction

Killarney Fern (*Vandenboschia speciosa* (Willd.) G.Kunkel) is a large filmy fern in the family Hymenophyllaceae. It is restricted to damp, shady and humid habitats and is extremely sensitive to desiccation. It has a typical fern two-stage life cycle. Both the sporophyte (typical fern frond) and gametophyte (filamentous structure) are capable of asexual reproduction, by mean of rhizomes in the former and gemmae in the latter. Gametophyte colonies can exist and reproduce in the absence of sporophytes.

In Ireland, when the sporophyte and gametophyte generations occur together, they occupy similar habitats that are deeply shaded and humid, such as dripping caves, cliffs, crevices by waterfalls and in woodland, and occasionally the floor of damp woodland. See Section 1.3 for details of the habitats of both *V. speciosa* generations when they occur together and separately.

The reported rare occurrence of sporophytic recruitment in conjunction with the persistence of both generations of *V. speciosa*, often occurring independently, has led to the conclusion that there has been a breakdown in the link in the life cycle between the sporophyte and gametophyte generations of *V. speciosa* (Sheffield, 1994).

Many colonies of the species contain a mixture of sporophyte and gametophyte generations. In Ireland, most sites are located in the south-west and south, particularly Counties Clare, Cork, Kerry and Waterford, but populations also occur in the east, west and north-west. The known extant Irish population comprises 501 colonies across 136 populations.

Table 1 below sets out the colony type abbreviations which will be used throughout this report:

Table 1 Abbreviations for *Vandenboschia speciosa* colony types.

Colony type	Colony type abbreviation
Sporophytes [mature] and gametophytes co-occurring	SG
Sporophytes, gametophytes and juvenile sporophytes co-occurring	SGJ
Sporophyte-only	S
Gametophyte-only	G
Gametophytes and juvenile sporophytes	GJ
Mature sporophytes with juveniles (without gametophytes observed)	SJ

1.1 Description of *Vandenboschia speciosa*

Vandenboschia speciosa is commonly known as the Killarney Fern or the Bristle Fern.

Other synonyms for this species include:

Didymoglossum alatum (Sm.) Desv., *Hymenophyllum alatum* Sm. non Schkuhr, *Trichomanes alatum* (Sm.) Hook., *Trichomanes andrewsii* Newman, *Trichomanes brevisetum* R.Br., *Trichomanes europaeum* Sm., *Trichomanes hibernicum* Spreng., *Trichomanes radicans* var. *andrewsii* (Newman) H.C. Watson & Dennes, *Trichomanes radicans* var. *andrewsii* Bab., *Trichomanes pyxidiferum sensu* Huds. non L., *Trichomanes radicans auct. non* Sw., *Trichomanes radicans* var. *speciosum* (Willd.) Hook.fil. nom. illeg., *Trichomanes speciosum* Willd.

V. speciosa differs from 'typical' ferns in that both generations can live independently of each other by reproducing vegetatively, the gametophyte by means of gemmae, which are asexual

propagules (Vogel *et al.*, 1993; Sheffield, 1994; Rumsey *et al.*, 1999) and the sporophyte by means of rhizome spread (Rumsey *et al.*, 1999). Such perennial growth in gametophytes has been reported in the Vittariaceae, Grammitidaceae and Hymenophyllaceae, which are all predominantly tropical families (Farrar, 1967; Raine *et al.*, 1991). Whilst the sporophyte has been known from Ireland since 1804, the gametophyte was first recorded in Britain in 1989 (Rumsey *et al.*, 1990; Rumsey, 1994) and in Ireland in 1992 (Rumsey *et al.*, 1998).

Figure 1 shows a line drawing of the life cycle of *V. speciosa* depicting the characteristic features of both the sporophyte and gametophyte generations.

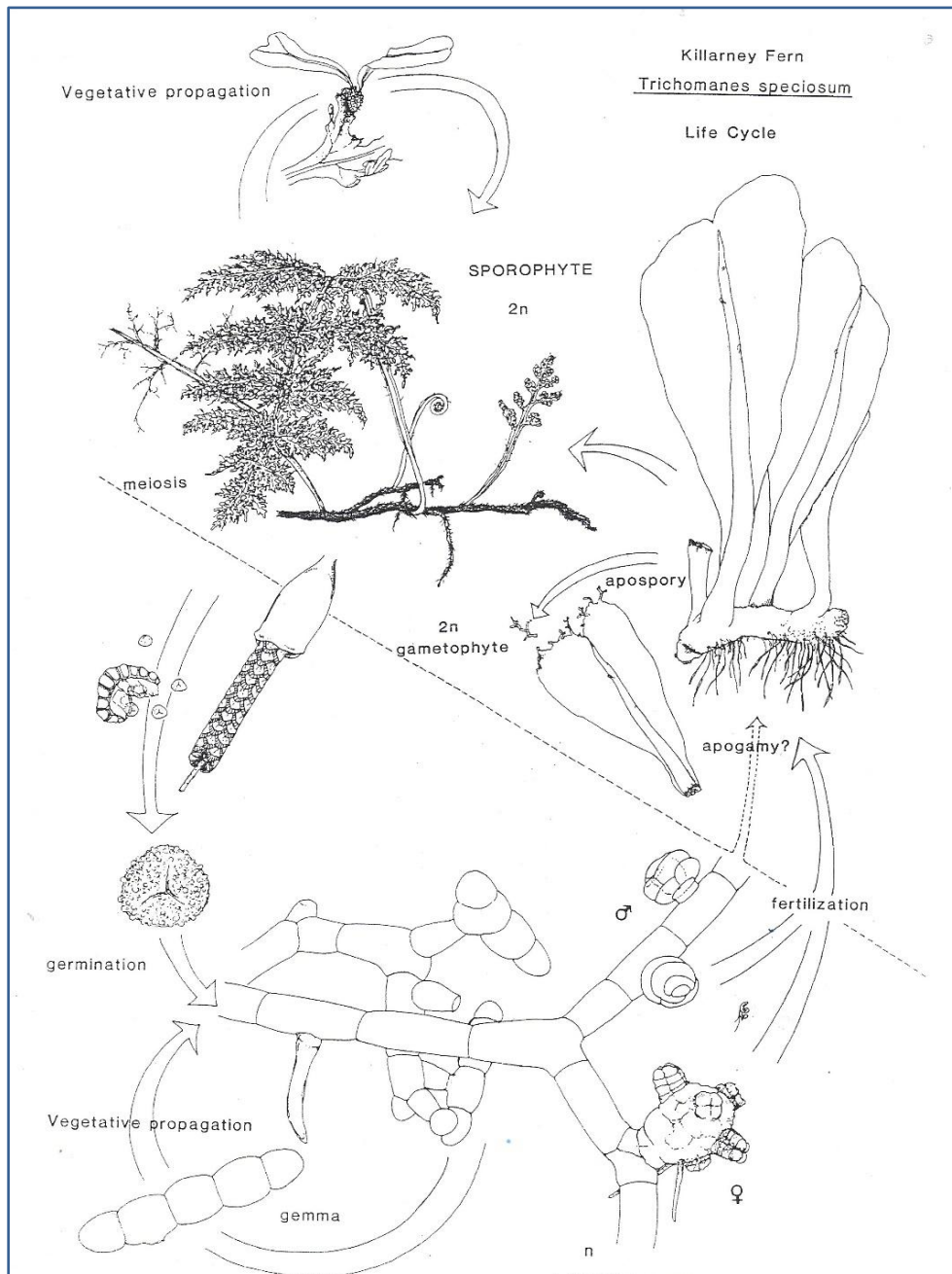


Figure 1 Illustration of the life cycle of *Vandenboschia speciosa* showing the sporophyte and gametophyte generations. Illustration shows the spore-bearing receptacle (bristle), stipe and rhizome which are characteristic features of the sporophyte generation, and also shows gemmae, gemmifers, a rhizoid and gametangia (antheridia and archegonia) on a gametophyte filament. Production of juvenile sporophytes is also depicted. Illustration by Fred Rumsey in Rumsey (1994).

1.1.1 *Vandenboschia speciosa* sporophyte generation

The *V. speciosa* sporophyte is a medium-sized, evergreen, perennial filmy fern with translucent membranous fronds that are light green when young and a deep, dark green when they mature. Images of *V. speciosa* fronds are shown in Figure 2. Fronds often hang from vertical rock surfaces but are also known to occur on the floor of damp woodlands. Frond length is reported to range from 20 to 45 cm (Page, 1997). The fronds are ovate to ovate-lanceolate in outline with a stipe (stalk) that typically occupies a third of the total frond length (Page, 1997).

The fronds are finely dissected with acutely tapering pinnae and a very thin lamina which extends down the pale green, rigid stipe forming a wing on either side (Page, 1997). This winged stipe is a characteristic feature of the sporophyte (Figure 3).

Fertile fronds have sporangia that develop within small urn-shaped receptacles that typically occur on the upper edge of each pinna (Page, 1997). The sporangia are attached to a hair-like bristle within these receptacles (Page, 1997). The spore-bearing, bristle-like receptacle is a characteristic feature of the genus *Vandenboschia* (Figure 3).

The rhizome of *V. speciosa* is covered in characteristic dark, hair-like scales (Page, 1997; Rumsey, 1997; Parnell & Curtis, 2012). The fronds arise singly from a creeping rhizome which can spread to form a branching rhizome network that can cover considerable areas in colonies that are undisturbed (Page, 1997). Sporophytes are easily identified in the field by a combination of the characteristic features mentioned above (see Figure 2 and Figure 3).

Juvenile sporophyte fronds emerging from gametophytes can be easily overlooked. These growths may arise from sexual reproduction or apogamy (it is not possible to determine their origin in the field). The fronds are simple with no pinnae pairs and no visible rhizome, and are usually ≤ 1 cm in length at this stage. They are light green in colour and easily blend in with the gametophytes. Figure 4 shows juvenile sporophytes emerging from gametophytes.

Maturing-juvenile sporophytes are recognisable as they have pinnae pairs developing (see Figure 5). This is the stage when maturing-juveniles are becoming young sporophytes. A rhizome is not visible at this stage. Other juvenile sporophytes often occur with the maturing-juveniles. They are a slightly darker green than the juveniles. Little is known about the survival rates of this stage of sporophyte development.



Figure 2 Top left: Unfurling *Vandemboschia speciosa* frond, National Botanic Gardens, Glasnevin, 2010. Top right: *V. speciosa* young expanding frond, population TS08, Co. Cork, 2010. Bottom: Mature *V. speciosa* frond, population TS07, Co. Carlow, 2011. Photographs Emer Ní Dhúill.



Figure 3 Top left: Fertile *Vandenboschia speciosa* frond, population TS08, Co. Cork, 2010. Top right: Close-up of bristles of fertile frond, population TS08, Co. Cork, 2010. Centre: *V. speciosa* colony with many fronds, population TS08, Co. Cork, 2010. Bottom: *Vandenboschia speciosa* rhizome and winged stipe, Azores, 2010. Photographs Emer Ní Dhúill.



Figure 4 Top left: Juvenile *Vandenboschia speciosa* sporophytes emerging from gametophytes on a rock with sparsely occurring gametophytes, population TS26, Co. Waterford. Top right: Juvenile sporophytes emerging from a dense mat of gametophytes, population TS26, Co. Waterford, 2017. Bottom: Juvenile sporophytes emerging from a dense mat of gametophytes interspersed with bryophytes, population TS24, Co. Kerry, 2011. Photographs Emer Ní Dhúill.



Figure 5 *Vandenboschia speciosa* maturing-juveniles from gametophytes at population TS24, Co. Kerry, 2023. Photograph Emer Ní Dhúill.

1.1.2 *Vandenboschia speciosa* gametophyte generation

The bright green gametophytes of *V. speciosa* form mats (sometimes termed “wefts”) of repeatedly branching, interwoven filaments that can cover extensive areas (Rumsey *et al.*, 1990) and that have a felt-like texture when touched. This filamentous perennial gametophyte is considered unique among European fern genera (Rumsey *et al.*, 1998). Key identifying features of *V. speciosa* gametophytes are green filaments, the presence of short brown unicellular rhizoids, gemmae (asexual propagules) and gemmifers (specialised cells upon which gemmae are produced) (Rumsey *et al.*, 1990, 1998). Figure 6 is a microscope image of the gametophyte filaments showing the rhizoids and Figure 7 shows gemmifers and a gemma in close-up (Merryweather, 2012). The individual cells of the filaments are typically 40–55 µm wide and 150–300 µm in length and are never more than three times longer than their width (Rumsey *et al.*, 1998). Each cell contains numerous discoid chloroplasts (Rumsey *et al.*, 1990). The gametophyte can often be identified by experts or those trained in its identification based on touch (the felt-like texture). Gametophytes are identifiable in the field using a hand lens (x10 or x20) or a portable microscope (x35), the latter being particularly useful for definitively identifying gametophytes that are heavily intermingled with bryophytes.

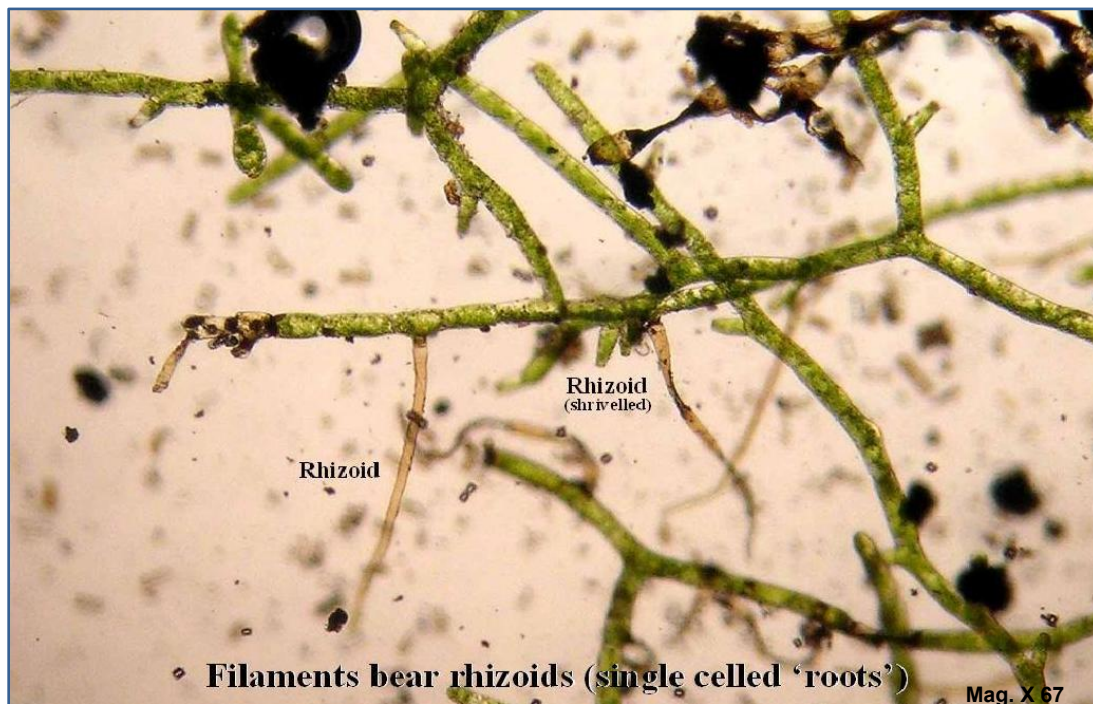


Figure 6 Microscope image of *Vandemboschia speciosa* gametophyte filaments showing brown unicellular rhizoids (magnification x67). Image from Merryweather (2012), reproduced with permission (note: magnification has been amended to reflect the size of the image copied to this document).

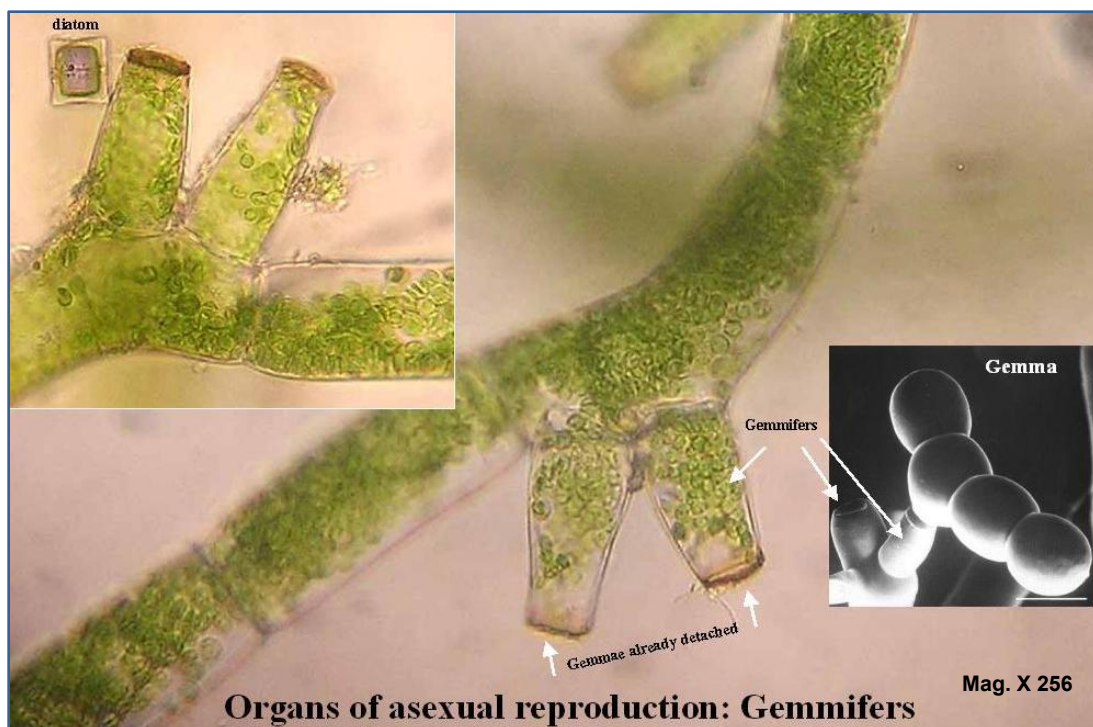


Figure 7 Microscope image of *Vandemboschia speciosa* gametophyte filament (magnification x256) showing gemmae (asexual propagules) and gemmifers (specialised cells upon which gemmae are produced). The upper left-hand corner of the image shows a diatom beside the gemmifers for scale. Images from Merryweather (2012), reproduced with permission (note: magnification has been amended to reflect the size of the image copied to this document).

An image of an extensive gametophyte colony observed hanging from a ravine wall at population TS26, Co. Waterford is shown in Figure 8. A smaller, patchy gametophyte colony observed at population TS24, Co. Kerry is shown in Figure 9. The density, patchiness and spread of gametophyte colonies can vary hugely. Under no circumstances should gametophytes be detached from the substrate on which they are growing, other than under licence from the National Parks and Wildlife Service (NPWS).



Figure 8 *Vandemboschia speciosa* gametophyte colony hanging from ravine wall, population TS26, Co. Waterford, 2017. Photograph Emer Ní Dhúill.



Figure 9 Patchy *Vandemboschia speciosa* gametophyte colony on a ravine wall, population TS26, Co. Waterford, 2017. Photograph Emer Ní Dhúill.

1.1.3 Definition of a *Vandenboschia speciosa* colony for both generations

The definition of a colony remains the same as reviewed and updated in the previous reporting period (Ní Dhúill *et al.*, 2022). It was found that the earlier definition of a *V. speciosa* colony was sufficient only for the sporophyte generation, *i.e.* the most suitable unit for measuring population size was considered to be the colony, which was simply defined as a discrete, *i.e.* unconnected, “patch” or “plant” (Ratcliffe *et al.*, 1993; Rumsey, 1997). With the sporophyte generation, each discrete colony is usually very obvious, occupying a crevice, wall or woodland floor. However, with the gametophyte generation the discrete “patches” are not always obvious – the best unit for defining a gametophyte colony was the niche in which the gametophytes occur, *e.g.* a particular boulder or crevice, cave, or section of cliff wall. These niches may contain a discrete gametophyte patch or numerous patches.

1.2 Distribution and range of *Vandenboschia speciosa*

V. speciosa is a Macaronesian-European endemic (Webb, 1993; Rumsey *et al.*, 2000). The distribution of *V. speciosa* sporophytes is believed to be confined to a limited area of Europe (Ireland, Britain, Western France, Spain and Italy) and the Atlantic Islands of the Azores, Madeira and the Canaries (Ratcliffe *et al.*, 1993). The gametophyte generation has a wider distribution and is reported also in Belgium (Christenhusz *et al.*, 2017), on the Czech-German border (Vogel *et al.*, 1993), Germany (Rumsey *et al.*, 1998), Luxembourg (Krippel, 2001) and Poland (Krukowski & Świerkosz, 2004). *V. speciosa* is the only European representative of the genus *Vandenboschia* (Vogel *et al.*, 1993; Rumsey *et al.*, 2000; Makgomol & Sheffield, 2001) and is most abundant in the Azores, outside of which it is most frequently found in Ireland and Britain (Ratcliffe *et al.*, 1993; Rumsey *et al.*, 2000). Ireland holds over 25% of the European sporophyte population (Wyse Jackson *et al.*, 2016).

There is great secrecy surrounding the exact locations of this species in Ireland and Britain, due to historic over-collection to the point of extinction of the sporophyte in some localities (Rumsey, 1994; Rumsey *et al.*, 1998). Although the threat of deliberate collection of the species is much reduced from levels pertaining heretofore during the “Victorian Fern Craze” (see Allen (1969) and Whittingham (2009)), there remains a low-level threat to some colonies from this activity. For this reason, the precise locations of colonies of the species are not made generally available.

Most populations of *V. speciosa* in Ireland occur in Co. Cork (West), Co. Clare, Co. Kerry (Stroh *et al.*, 2023; Ó Catháin, 2023a), with the largest known population occurring in Co. Waterford (population TS26). An historic record for the *V. speciosa* sporophyte generation had previously been known from Co. Clare (found by T.H. Corry in 1879), the sole record for the species from the county, but had not been included in previous Article 17 assessments as the cut-off period for records was 1960. However, intensive recording between 2020 and 2024 has revealed the presence of a considerable number of hitherto unknown populations for the species (both sporophyte and gametophyte generations) in Co. Clare, as well as the rediscovery of the sporophyte at Corry’s 1879 site (TS125.01.01) (Ó Catháin, 2023a, b, 2024a, b; Roden *et al.*, 2021).

There are outlying sites with sporophytes in counties Carlow, Donegal, Limerick, Sligo, Tipperary, Waterford and Wexford (Curtis & McGough, 1988; Ní Dhúill *et al.*, 2015, 2022; NPWS, 2024, 2025a; Stroh *et al.*, 2023; Wyse Jackson *et al.*, 2016; NPWS internal files). The first records for sporophytes in Co. Wexford (TS77) since the EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) came into force were made during the course of this survey, with juvenile and maturing-juvenile sporophytes recorded with gametophytes. The gametophyte range is similar but is more widespread and also occurs in counties Cavan, Louth, Galway, Kilkenny, Mayo, and Wicklow, (Flynn, 2024; Ní Dhúill *et al.* 2015, 2022; NPWS, 2024; 2025a; Preston *et al.*, 2002; Rumsey *et al.*, 1998; Stroh *et al.*, 2023; NPWS internal files). *V. speciosa* was recorded

from Co. Louth for the first time in 2021 (gametophyte generation, population TS123) (Flynn, 2024).

All extant Connacht populations comprise gametophyte-only colonies except for one population in Co. Sligo (TS17), where both sporophyte and gametophyte colonies are found. Prior to this current reporting period (2019–2024) there was only one recent record for sporophytes in Leinster (Co. Carlow (TS07)), with all other known extant records in the province being gametophyte-only. However, as noted above, a first record for sporophytes in Co. Wexford was made in 2024.

Previously, the sporophyte generation of *V. speciosa* also occurred in Co. Wicklow, but it has not been recorded from here since the 19th century, probably on account of being lost to over-collection and/or habitat change. The gametophyte currently occurs in four populations in Co. Wicklow (populations TS03, TS04, TS56, and TS122).

Figure 10 shows the range and distribution map of *V. speciosa* in Ireland (10 km x 10 km grid squares, known as hectads), based on 1960–2024 records from 136 extant populations. There are currently 78 Irish National Grid 10 km x 10 km squares in the Republic of Ireland in which *V. speciosa* has been recorded between 1960 and 2024, covering an area of 7,800 km².

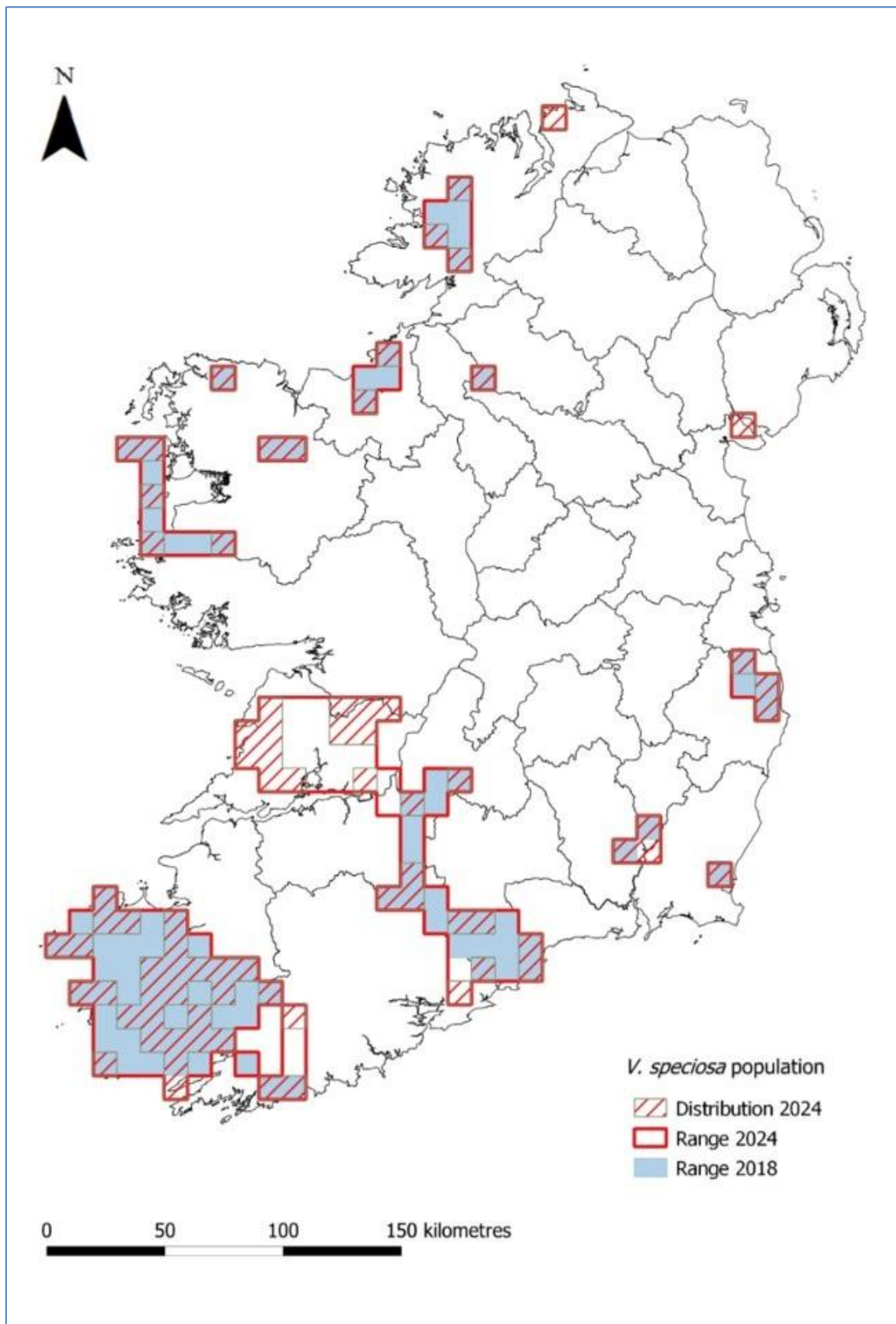


Figure 10 Range and distribution map of *Vandeboschia speciosa* in Ireland (10 km x 10 km grid squares), based on 1960–2024 records from 136 populations, as documented in NPWS (2025a). Red diagonal lines and red outline represent the 1960–2024 distribution and range respectively, and the blue shading represents the 1960–2018 range.

1.3 Habitat of *Vandeboschia speciosa*

V. speciosa occurs at a range of altitudes in Ireland from sea level to 700 m (population TS85, Co. Kerry). In Ireland, *V. speciosa* occurs in both open and wooded habitats where relative humidity is constantly high. In the open habitats, shade is usually provided by aspect and often by boulders, cliff overhangs or crevices where *V. speciosa* occurs. In wooded habitats, shading is also provided by the overhead canopy. *V. speciosa* occurs in sites with a predominantly north or north-east-facing aspect, and on acidic substrates such as slates and sandstones (Ratcliffe *et al.*, 1993; Page, 1997; Kingston & Hayes, 2005), avoiding strongly acidic conditions and often growing where there is slightly basic or mineral-rich influence. Whilst the sporophyte has been known from Ireland since 1804, the gametophyte was first recorded in Britain in 1989 (Rumsey *et al.*, 1990; Rumsey, 1994) and in Ireland in 1992 (Rumsey *et al.*, 1998).

In Ireland, *V. speciosa* sporophyte and gametophyte generations occur together in dripping caves, cliffs, crevices and gullies by waterfalls, crevices in woodland, and occasionally sporophytes occur on the floor of damp woodland – all deeply shaded humid habitats (Ratcliffe *et al.*, 1993; Rumsey, 1994; Johnson *et al.*, 2000; Kingston & Hayes, 2005; Ní Dhúill, 2014). Sporophyte colonies, however, are more restricted in the habitats in which they occur in Ireland than gametophyte colonies. Sporophytes usually occur on permanently wet rock faces, caves or river/stream banks, with constant dripping of water a typical feature of their habitat. Gametophyte colonies have been reported from less humid habitats (Ratcliffe *et al.*, 1993; Rumsey, 1994; Kingston & Hayes, 2005; Ní Dhúill, 2014). Gametophytes can grow in very dark habitats where there is little competition from other species and do not grow directly in the path of dripping or flowing water. Niches that the gametophyte generation can occupy are often not suitable for the growth of sporophytes, *i.e.* shallow crevices in otherwise open habitats that provide adequate shade and relative humidity for gametophytes, but not for the larger sporophytes.

V. speciosa sporophytes often occur in ravines and near streams in damp woodland habitats and near mountainous cascades and waterfalls in open upland habitats, all very specific microhabitats, which aids in determining likely locations for the occurrence of this generation. The habitat of the gametophyte generation, however, is not as narrow as it can survive in drier, though still very humid, microhabitats, although its specific niche can often be quickly identified by the trained eye.

The difficulty in adequately and categorically describing the habitat of this species reflects the wide variety of situations in which it occurs. Sporophyte-only and gametophyte-only colonies occupy slightly different ecological niches, with gametophyte-only colonies occurring in deeper shade with rock seepage being the main water source, whereas sporophyte-only colonies tend to occur in higher light conditions with constant dripping water a typical feature of its habitat (Ní Dhúill, 2014). Relative humidity levels were found to be generally uniform throughout study sites, regardless of habitat type, with constant high levels of relative humidity (on average > 90%) recorded at all populations visited (Ní Dhúill, 2014).

Although there are many apparently suitable sites around Ireland, especially in the south-west of Ireland, there is no real understanding of why the sporophyte of this species is restricted to particular sites. Ratcliffe *et al.* (1993) found the absence of the sporophyte from many apparently suitable habitats in its range to be puzzling. A lack of suitable continuous habitat and the effects of historic depredation of the sporophyte generation during the “Victorian Fern Craze”, also known as “Pteridomania”, which was at its height in the 1850s–1890s (Allen, 1969; Whittingham, 2009), may, at least partly, explain the distribution of this species in Ireland. There are a number of other factors that may explain the absence of this species from seemingly ideal habitats, such as a lack of suitable substrate, inadequate shading, inadequate temperature and inadequate relative humidity levels, *i.e.* high relative humidity levels may only be intermittent rather than constant.

1.4 Rationale for baseline and monitoring surveys

1.4.1 Article 17 of EU Habitats Directive

The EU Habitats Directive aims to maintain at, or restore to, a Favourable Conservation Status the habitats and species that are of Community Importance (European Commission, 1992; Evans & Arvela, 2011; DG Environment, 2017, 2022). This is one of the most important pieces of legislation for the conservation of biodiversity in Europe and was transposed into Irish law in the European Communities (Natural Habitats) Regulations (S.I. No. 94 of 1997). The Directive lists threatened habitats in Annex I and species in Annexes II, IV and V. Article 17 of the Habitats Directive requires that each Member State must report to the European Commission every six years on the conservation status of listed habitats and species. The most recent round of reporting, covering the period 2019–2024, was submitted and published in 2025 (NPWS, 2025a, b, c) and is the fourth round of reporting carried out under Article 17 where the conservation status is assessed.

V. speciosa is listed (as *Trichomanes speciosum*) in Annexes II and IV of the Habitats Directive. For species listed in Annex II of the Directive, Member States are required to designate Special Areas of Conservation (SACs).

All populations of *V. speciosa* are also protected under the Flora (Protection) Order, 2022 (S.I. No. 235 of 2022). The species is currently categorised as Least Concern (LC) on the All-Ireland Red List based on separate assessments for sporophyte, gametophyte and both generations combined (Wyse Jackson *et al.*, 2016). However, due to its specific habitat requirements and the fact that both generations of *V. speciosa* are very slow-growing, the species is potentially threatened by a wide variety of activities (outlined in Section 2.3.4); monitoring, management and protection of sites and populations is thus of prime importance for the maintenance of the conservation status of the species.

NPWS commissioned BEC Consultants Ltd, in conjunction with independent consultants, to carry out baseline and monitoring surveys of selected Irish populations of the Annex II species *Vandenboschia speciosa* (Willd.) G.Kunkel [EU species code 6985] for the 2019–2024 monitoring period. The outputs of the survey informed the 2025 EU Habitats Directive Article 17 report (NPWS, 2025a).

1.4.2 Assessment of EU Habitats Directive Annex II species

The most recent guidelines for assessing the conservation status of habitats and species are provided in DG Environment (2022). The conservation status of Annex II species is assessed under four parameters: (1) *Range*, (2) *Population*, (3) *Habitat for the species* and (4) *Future prospects*. 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 Conservation Status Assessment for the species.

Table 2 General evaluation matrix for assessment of Conservation Status of a species (from DG Environment (2022)).

Parameter	Conservation Status			
	Favourable ('green')	Unfavourable –Inadequate ('amber')	Unfavourable–Bad ('red')	Unknown
Range	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
Population	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
Habitat for the species	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
Future prospects (with regard to population, range and habitat availability)	Main pressures and threats to the species not significant; species will remain viable on the long-term	Any other combination	Severe influence of pressures and threats to the species; very bad prospects for its future, long-term viability at risk.	No or insufficient reliable information available
Overall assessment of Conservation Status	All 'green' OR three 'green' and one 'unknown'	One or more 'amber' but no 'red'	One or more 'red'	Two or more 'unknown' combined with green or all 'unknown'

Elements of this national assessment approach can be scaled down to assess the status at a population level by assessing *Population*, *Habitat for the species* and *Future prospects*. *Range* was assessed separately for the final National Conservation Status Assessment report. The results are combined to provide an overall National Conservation Status Assessment.

Population assesses the number of colonies of each generation at each population (sporophytes and gametophytes co-occurring; sporophytes, gametophytes and juvenile sporophytes co-occurring; sporophyte-only; gametophyte-only; gametophytes and juvenile sporophytes; or mature sporophytes with juvenile sporophytes (without gametophytes observed)), frond counts for colonies where sporophytes occur (actual or estimated) and whether a population is reproductively viable by observation of fertile fronds or juvenile sporophytes emerging from gametophytes. Colony losses (if any) are expressed as a percentage loss since the last reporting period. Area of occupancy (m²) and maximum area (m²) are also included in the *Population* assessment. Current values are compared with baseline target values to assess if the population is of Favourable Conservation Status.

Habitat for the species assesses the area and quality of the habitat in which the species occurs. It is assessed by means of several criteria, devised by Ní Dhúill *et al.* (2015) and updated following the last reporting period (2013–2018) (Ní Dhúill *et al.*, 2022). Updated criteria include water source, substrate moisture, shade, canopy cover (in woodland locations) and the presence of invasive alien species or vigorous/problematic native species within close proximity of the sporophyte generation, including if providing essential canopy cover (e.g. *Rhododendron ponticum* or *Prunus laurocerasus*). Current values are compared with baseline target values that assess if the *Habitat* for the species is of Favourable Conservation Status.

Future prospects are assessed by examining whether any activities are affecting the other parameters (i.e. *Range*, *Population* and *Habitat for the species*) and what their impact would be if they continue unchecked. *Future prospects* should balance any positive and negative activities to determine if they are likely to impact the species or habitat within the next two reporting cycles (12 years) and likely to affect the long-term viability of the species or its habitat.

1.5 *Vandenboschia speciosa* surveys in Ireland

Baseline data for the conservation status of *V. speciosa* in Ireland were gathered during the reporting period 2007–2012. Table 3 below shows the population size that was reported on in each of the reporting periods (2007–2012, 2013–2018, 2019–2024). Short summaries of the previous reporting periods are outlined in Sections 1.5.1, 1.5.2, and 1.5.3.

Table 3 *Vandenboschia speciosa* population size reported over the last three reporting periods (2007–2012, 2013–2018, 2019–2024) showing population and colony numbers.

Reporting period	No. of populations monitored	No. of colonies monitored	No. of known extant populations	No. of known extant colonies
2007–2012	27	79	64	177
2013–2018	40	198	86	290
2019–2024	49	284	136	501

1.5.1 Baseline survey 2014

In 2008, the National Parks and Wildlife Service commissioned a Ph.D. research project (Ní Dhúill, 2014) to monitor *V. speciosa* to determine the conservation status of the Irish populations and to assess the genetic variability of the species in Ireland. The research aimed to fulfil the aspirations of the Species Action Plan (Anonymous, 2008) and to develop a monitoring protocol to help fulfil national obligations on reporting under the EU Habitats Directive. The areas of research dealt with gathering baseline data on the habitat and ecology of both generations of this species in Ireland. This followed on from a previous study on the ecology and conservation of the gametophyte generation in Ireland (Kingston & Hayes, 2005). Genetic identity and genetic diversity of the Irish *V. speciosa* populations, and the frequency of sporophytic recruitment, were assessed.

Visits to 27 Irish populations revealed a higher occurrence of fertile colonies (57%) than had been previously recorded. The rarely observed juvenile sporophytes emerging from gametophytes were recorded at five Irish populations. Site surveys revealed that the majority of populations that support sporophytes typically have gametophytes growing intimately or in close association with the sporophytes. The presence of fertile sporophytes, juvenile sporophytes emerging from gametophytes and gametangia (organs producing male and female gametes) were considered to be good indicators of colony health as these provided an indication that historic or recent sexual reproduction may have occurred.

The research found no associated species that would unequivocally indicate the presence of either generation, as supported by previous studies (Ratcliffe *et al.*, 1993; Rumsey, 1994; Kingston & Hayes, 2005).

Genetic analysis of Irish populations of *V. speciosa* using Amplified Fragment Length Polymorphism (AFLP) revealed that genetic diversity was partitioned within and among populations of both generations analysed (Ní Dhúill, 2014). Samples analysed showed the majority of *V. speciosa* populations to be genetically distinct and as such each is of conservation importance throughout its distribution range in Ireland (Ní Dhúill, 2014). Genetic diversity was revealed in both generations, with the gametophytes exhibiting genetic diversity not present in the sporophyte generation. This is a potential source of novel genetic variation in a future sporophyte generation in the event of sexual reproduction resulting in successful sporophyte recruitment. The gametophyte generation is acting as a potential ‘genetic bank’ and as such is of conservation importance (Ní Dhúill, 2014).

Recommendations to maintain the species in Favourable Conservation Status *in situ* were proposed and included six-yearly monitoring periods to assess the condition of each population. *Population* structure was assessed based on colony area, frond types and numbers, frond measurements, presence of associated gametophytes, fertility and presence of juvenile sporophytes. *Habitat for the species* was assessed based on relative humidity, shading, canopy cover, bare rock and vegetation plots to assess the presence of invasive species in the vicinity of sporophyte colonies. *Future prospects* were assessed based on the observation of any activities impacting on the population or habitat. Pressures and threats mostly related to the presence of the invasive non-native species, *Rhododendron ponticum* and *Prunus laurocerasus* at a number of populations. The overall Conservation Status for the national population was assessed as Favourable.

The results provided baseline data on the Irish *V. speciosa* populations and a monitoring protocol relevant for informing reporting structures to the EU under Article 17 of the EU Habitats Directive.

1.5.2 Monitoring protocols 2015

Based on the results of the surveys and recommendations of the Ph.D. research (Ní Dhúill, 2014), a monitoring manual (Ní Dhúill *et al.*, 2015) was published that included refined monitoring protocols to assess the conservation status of the Irish populations in order to meet EU Habitats Directive obligations. The four parameters assessed were *Range*, *Population*, *Habitat for the species* and *Future prospects*, all of which were deemed to be Favourable nationally. The results of the assessments were used to inform the National Conservation Status Assessment for the 2007–2012 reporting cycle (NPWS, 2013). There were five populations for which overall Conservation Status was assessed as Unfavourable, the result of localised impacts that were not regarded as a threat at the national level.

1.5.3 Monitoring and surveys for reporting period 2013–2018

A survey of 40 *V. speciosa* populations comprising 198 colonies was conducted between 2015 and 2018 to monitor and assess this species as part of the Rare Plants Monitoring Survey. The outputs of the survey fed into Ireland’s 2019 EU Habitats Directive Article 17 submission

(NPWS, 2019). The conservation status of this Annex II species was assessed under four parameters as outlined in Section 1.5.2 above.

This assessment resulted in seven populations receiving an Unfavourable–Inadequate conservation assessment. This outcome was due to significant impacting activities recorded at those populations, e.g. invasive alien species, vigorous native species, loss of canopy cover, bank slippage and pathogen attack. These activities often related to a single colony in multiple-colony populations; however, if one colony within a population had an Unfavourable–Inadequate Conservation Status, then this followed for the whole population. These impacting activities were considered to be local issues and were not regarded at that time as a threat at the national level. The remaining 33 monitored populations received a Favourable conservation assessment. The overall Conservation Status for *V. speciosa* in Ireland was assessed as Favourable.

The presence of fertile sporophytes and juvenile sporophytes emerging from gametophytes were considered to be good indicators of colony health as these provided an indication that historic or recent sexual reproduction may have occurred. During the 2007–2012 reporting period, juvenile sporophytes were rarely observed within the Irish populations, being recorded in five of the 27 monitored populations (18%). Since then, there was an increase in recording of *V. speciosa* juvenile sporophytes emerging from gametophytes, which may be the result of sexual reproduction or apogamy. In the 2013–2018 reporting period, during the Rare Plants Monitoring Survey, juvenile sporophytes were recorded at 12 of the 40 monitored populations (30%). The trigger for the development of these juvenile sporophytes emerging from gametophytes is unclear but may, at least in part, be due to climatic factors.

A review of the methodology was undertaken (Ní Dhúill *et al.*, 2022), and a number of refinements and recommendations were made.

It was recommended that the presence of invasive alien species, such as *Rhododendron ponticum*, *Prunus laurocerasus*, *Reynoutria japonica* and *Acaena ovalifolia* (and perhaps *Epilobium brunnescens*), within a population, in the vicinity of any sporophyte colonies or providing shade to any colonies, be used as an indicator for the *Habitat for the species* parameter. This approach was recommended rather than simply using those invasives that occur within one metre of a sporophyte colony, as two main problematic invasive species (*R. ponticum* and *P. laurocerasus*) would not occur within a *V. speciosa* sporophyte colony. The positive impacts would be balanced against any negative impacts arising from the presence of these species in locations where they occur with the sporophyte generation. The target would be “no obvious impact on the colony”. If the invasive alien species or vigorous native species is providing essential canopy cover, then this would result in a pass for that indicator. However, if a negative impact is observed, such as bank slippage in the vicinity of the sporophyte colony, this would result in a fail for this indicator. This refinement was recommended for populations that contain sporophytes in either woodland or open upland habitats. This will aid in the assessment and understanding of the impact that invasive species have on *V. speciosa* colonies.

For gametophyte-only populations, the indicators for assessing *Habitat for the species* were shade (Shade Index) and relative humidity using a thermohygrometer. It was recommended to use only the indicator ‘substrate moisture’ rather than ‘humidity/substrate moisture’ as, although the recording of relative humidity is useful, the locations where gametophyte-only colonies occur typically have a moist substrate. This generation is known to occur in less humid conditions than the sporophyte generation; however, relative humidity was always >80% and typically >90% for both generations. This amendment will streamline surveys and reduce the amount of equipment required.

For the *Population* assessment it was recommended that the sporophyte and gametophyte areas be reported separately for the next reporting period instead of the combined figure. These figures are set out in the Individual Site Assessment Sheet. This will make comparisons between generations and between years clearer and make it easier to highlight changes that may be affecting one generation and not the other.

1.6 Monitoring and baseline surveys 2019–2024

NPWS commissioned BEC Consultants Ltd, in conjunction with independent consultants, to carry out the survey detailed in this report, the aims of which were set out by NPWS as follows:

- Baseline monitoring and surveys of *V. speciosa* in Ireland of 50 selected populations.
- Provide a survey report and NPWS Rare Plant Survey site report for each population surveyed.
- Provide individual site assessments for each population surveyed.
- Review and update Natura 2000 Standard Data Forms and Site Synopses of SACs for which *V. speciosa* is a Qualifying Interest (QI).
- Complete the Article 17 National Conservation Assessment report for *V. speciosa*.

2 Methodology

2.1 Site selection

Fifty populations were selected by NPWS prior to commencement of the survey. Twenty of these populations had been surveyed during the previous reporting period (2013–2018). There was one change in the selected sites, with population TS30, Co. Cork, visited instead of TS47, Co. Kerry, which was agreed with NPWS in advance.

Populations were selected to cover the geographic range of the species in Ireland and also the occurrence of the different generations, *i.e.* sporophyte, gametophyte, and co-occurring generation populations, and populations with juvenile sporophytes. There was, however, a greater focus on populations where adult sporophytes occurred, with 39 such populations listed for survey out of the 50 selected sites. One sporophyte-only population was not rediscovered (TS45, Co. Donegal) but is not considered extinct. Figure 11 shows the locations of 49 *V. speciosa* populations monitored during the “Baseline and monitoring surveys of selected populations of *Vandenboschia speciosa* in Ireland, 2021–2024” project, with different coloured dots indicating the generations occurring within each population.

2.2 Survey preparation

2.2.1 Site packs

Data on *V. speciosa* populations, published and unpublished sources, and information held by NPWS were collated and studied prior to commencement of field work. NPWS Conservation Rangers were contacted in advance of the survey. Permission from landowners was sought on privately-owned land. All surveys were carried out under licence from NPWS.

A site pack was set up for each of the 50 selected populations proposed for survey. For the 20 populations previously surveyed, the site pack contained the site reports produced by Ní Dhúill *et al.* (2015, 2022), a field map consisting of an aerial photograph of the site showing the location of populations, and an Ordnance Survey map. In addition to this, a blank site survey card for the population to be completed by the ecologists was included (see Appendix 1), along with blank monitoring sheets to be completed for every colony within the population (Appendix 2).

For the 30 populations not previously monitored, the site packs contained an aerial image map showing the approximate location of the populations based on historic grid references, which were often only accurate to 100 m or more. An Ordnance Survey map was included to aid the assessment of access, especially for upland populations where access can be difficult. Also included were available details of the locations of populations, their habitats and colony status.

2.2.2 Data recording

Grid references (in Irish National Grid) were recorded for each colony within a population using a hand-held GPS. A ruggedised tablet was used to collect vegetation data within Turboveg SD (Alterra, The Netherlands) for baseline surveys. A QField project containing a shapefile with the locations of all known colonies of *V. speciosa* was also uploaded to the ruggedised tablet. Site and population data were recorded on paper survey cards.

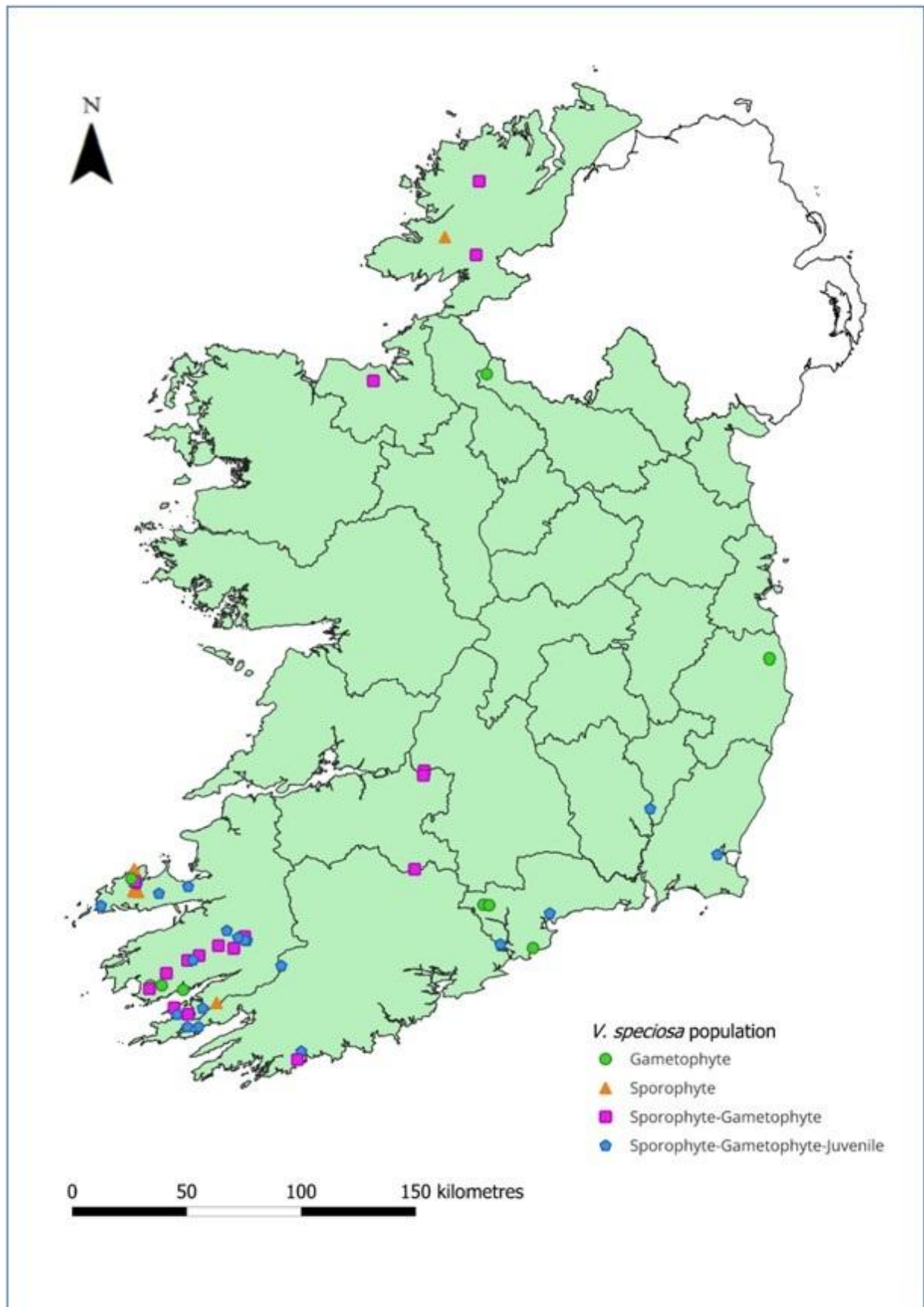


Figure 11 Distribution of the 49 *Vandenboschia speciosa* populations monitored during the 'Baseline and monitoring surveys of selected populations of *Vandenboschia speciosa* in Ireland, 2021–2024' project. Points for populations are coloured based on the generations they contain (see legend).

2.3 Site surveys

For the current, 2019–2024, reporting period, surveys were carried out between the months of April and September. The previous monitoring report (Ní Dhúill *et al.*, 2022) recommended that monitoring and survey of the gametophyte generation of *V. speciosa* could be carried out at any time of the year, depending on weather conditions. It also recommended that surveys of populations with sporophytes could take place between March and November, when canopy cover would be mostly intact, and fertile fronds, which are long-lived, would also be expected to be observed. Monitoring populations earlier in the year makes access easier, especially in open upland habitats where *Pteridium aquilinum* and *Molinia caerulea* form dense swathes across the mountain slopes, often covering boulders and holes. Visibility of the terrain makes access safer and quicker in such locations. Shorter day-length for surveys later in the year is a constraint.

In some sites, growth of *Rubus fruticosus* agg. in response to treefall, and other changes, presented access problems, which were overcome by revisiting the sites earlier the following year.

Photographs of site overview and colony location were taken at each visit, including close-up images of individual colonies, fronds and gametophytes. Photographs of any impacting activities were also taken, such as invasive alien species, landslides, bank slippage and loss of canopy cover. Photographs were included in the project's Image Databank. Any notable plants encountered in the vicinity (e.g. Red List or Flora (Protection) Order species) were noted and their location recorded.

For baseline surveys, the vegetation in a 2 m x 2 m plot was recorded at each site if the habitat of the species exceeded this area. If the habitat occupied a smaller area than this, the plot size used was appropriate to cover the habitat present. As the niche occupied by *V. speciosa* colonies is typically small, especially for gametophyte colonies, a 2 m x 2 m plot placed around the colony would often take in significant areas of unsuitable habitat. A plot of 25 cm x 25 cm was also recorded to cover the immediate associates of *V. speciosa*, nested within the larger plot. Within each plot, the percentage cover of all species present was recorded, as was the cover of bare rock, bare soil, leaf litter and the various vegetation components.

In addition to site survey packs and suitable waterproof field work attire, field survey equipment included: hand lens x10 and x20 (with light), handheld GPS, ruggedised tablet, walking stick, head torch, measuring tape, compass and a 25 cm x 25 cm quadrat. It is recommended that waders or thigh-high wellington boots are used when surveying populations that require access via rivers or streams.

The survey methodology can be broadly divided into four main tasks, with one additional task for baseline surveys:

1. Initial search for colonies of both generations of *V. speciosa*, whether co-occurring, gametophyte-only or sporophyte-only
2. Completing the site monitoring sheet for direct attributes of the sporophyte generation of each colony within a population, *i.e.* sporophyte colony structure
3. Completing the site monitoring sheet for direct attributes of the gametophyte generation of each colony within a population, *i.e.* gametophyte colony structure
4. Monitoring the direct attributes of the individual colonies, *i.e.* Habitat for the species and impacting activities
5. For baseline surveys, recording of vegetation data for each colony using 2 m x 2 m and 25 cm x 25 cm plots, with data held in Turboveg SD (Alterra, The Netherlands)

2.3.1 Initial search for colonies

Depending on the precision of grid references and location details in the available records of the populations for survey, the amount of time required to carry out a thorough search for both generations varied from population to population. The locations where the sporophytes occur include ravines, cliffs and by waterfalls. Searching such terrain was carried out with care, as some colony locations can be very difficult to access. In populations where sporophytes occur, a thorough search for the often-associated gametophyte generation was conducted in the immediate vicinity of rocky substrates, crevices, overhangs and boulders, even if the population was previously recorded as sporophyte-only.

For gametophyte-only populations, a thorough search of any likely niches was conducted for other gametophyte colonies, such as any rocky substrates, crevices, overhangs and boulders.

Sporophytes and gametophytes were monitored as separate entities, even when both generations were co-occurring.

2.3.2 Monitoring direct attributes of the sporophyte generation

At each population and colony where sporophytes occurred, the population structure was recorded to include investigation of the presence of gametophytes occurring intimately or in close association with the sporophyte generation, presence of sterile and fertile fronds, presence of croziers, presence of juvenile sporophytes emerging from gametophytes, presence of maturing-juvenile sporophytes, and presence of young or unfurling fronds.

At populations that were historically recorded as sporophyte-only based on NPWS records, it was important to search likely niches for gametophytes within any sporophyte colonies recorded prior to 1992, which is when the gametophyte generation was first recorded in Ireland. During the baseline survey (Ní Dhúill, 2014), gametophytes were observed at nine of the 12 (75%) populations that were historically recorded as being sporophyte-only, making it likely that gametophytes would be observed in the vicinity of sporophytes during the current project.

The extent of each colony was measured with a measuring tape. As the colonies (both gametophytes and sporophytes) are irregular in shape, they were measured as a rectangle, one measurement across the maximum dimension and another perpendicular to this. A 5 m measuring tape was generally suitable, however, for some larger colonies, a 10 m or 20 m measuring tape was more suited. These measurements of extent defined a rectangle which encompassed the colony, which was considered the maximum colony area (m²). The percentage of the area within the rectangle occupied by *V. speciosa* was visually estimated to allow calculation of the area of occupancy (m²) within this rectangle. For inaccessible colonies, e.g. at the back of a deep, narrow crevice, or high up on a bank or cliff, where use of a measuring tape was not feasible, maximum area and area of occupancy were visually estimated.

Full frond counts were carried out where possible at each colony, and estimates were calculated where counts were impractical. In the case of actual frond counts, these could be carried out on easily accessible colonies that were usually <1 m². The following frond types, and the numbers of each present, were recorded:

- Mature sterile fronds (>50% green, fully expanded)
- Mature fertile fronds (>50% green, fully expanded)
- Young expanding fronds (still unfurling, not fully expanded, arising from rhizome (vegetative reproduction))
- Unfurling fronds (Croziers)
- Juvenile fronds (emerging from gametophytes)

- Maturing-juveniles (previously juveniles from gametophyte, now becoming young fronds) (reproduction either sexual or apogamous)
- Browning (dying) fronds (<50% green)
- Dead fronds (blade ± intact but frond all brown)

In the case of larger colonies, estimates were carried out based on counts using 25 cm x 25 cm quadrats (1–3 quadrats used, depending on colony size). These quadrats were placed at different sections of the colony to ensure an accurate reflection of density variation of a colony, and the number and types of fronds in each quadrat were recorded. The density of fronds per square metre and the estimated area of occupancy of each colony were used to estimate the total colony frond numbers. For populations that comprised multiple sporophyte colonies, frond counts for each colony were added together to give the full frond count for the population.

For inaccessible baseline colonies, frond numbers were based on estimates from a colony of similar density within the population, or a visual estimate, with a note on which method was used. For inaccessible colonies that had previously been surveyed in the last two reporting periods, the number of fronds previously recorded was used for the current reporting period.

The number of juvenile fronds was counted or visually estimated and reported separately.

It has been reported that fertile fronds begin to brown and wither after complete spore discharge (Ratcliffe *et al.*, 1993; Page, 1997). This may occur over a number of years and colonies may show a significant reduction in fertile frond numbers compared to the baseline. Percentage fertility of colonies was calculated based on living frond counts. Analysis of colony frond counts during the baseline survey suggested that fertile fronds had a shorter life span than sterile fronds as they tended to brown and die after all sporangia have been released (Ní Dhúill, 2014). This may have implications on future monitoring of frond numbers as fluctuations in counts may reflect natural mortality of fertile fronds rather than any other factor impacting the colony. In such cases, expert judgement was used to determine if frond number reduction was due to natural turnover or if a pressure was acting on the colony.

2.3.3 Monitoring direct attributes of the gametophyte generation

The rectangle defining the extent of each colony, *i.e.* maximum area, was measured with a measuring tape, using the same method as used for the sporophyte generation, with a visual estimate of the area of occupancy (m²). The area of occupancy within this rectangle was then estimated (%), *i.e.* the percentage extent of the area within the rectangle occupied by *V. speciosa* gametophytes.

Quite often, in a particular niche, there were dense patches of gametophytes that petered out and were sparse at the peripheries, but continued on into other gametophyte patches, *e.g.* running along horizontal or vertical crevices. These sparse gametophytes were often difficult to see but could be observed with a good torch and hand lens. Gametophyte patches were sometimes also connected beneath bryophyte mats, making them difficult to observe. At other times, there were many discrete gametophyte patches within a given niche; however, it was not feasible to measure every single patch. For gametophyte patches that were not obviously discrete, or that were too numerous to measure individually, as was often the case, the maximum extent of the area of the particular niche occupied by gametophytes was measured and an estimated percentage area of occupancy was assigned based on a visual inspection. In such cases, the gametophytes within the niche were considered a colony.

A description of the colony was important to note, *i.e.* sparse, dense, wefts (felted mats of interwoven filaments), or patchy, as well as where the dense and sparse parts of the colony were, *i.e.* floor, wall, ceiling, and their location within the colony (left, centre, right). If heavily interspersed with bryophytes, this was also recorded. These notes will aid future monitoring to determine if there has been any change in this extremely slow-growing generation.

In the *Population* assessment (see Section 2.4.1) for this current report, the combined areas of occupancy for both generations are reported for comparative reasons, but the assessment takes into account the issues regarding the subjectivity of the gametophyte area of occupancy in terms of the target passing or failing.

Where the gametophyte colony occurred with sporophytes, the proximity of the gametophytes to the sporophytes was recorded, *i.e.* within or around. A good description of the gametophyte colony will give any future recorders a sense of the expected appearance of the overall colony, and any changes may be more easily observed.

During monitoring visits, investigation by an expert for the presence of gametangia and also emergence of juvenile sporophytes is recommended if this can be achieved with minimal disturbance; this will require a hand lens or portable field microscope. Niche availability in terms of available bare rock in the vicinity was investigated for the presence of adjacent unrecorded gametophytes.

2.3.4 Monitoring *Habitat for the species* and impacting activities

The *Habitat for the species* was assessed based on the area and quality of the habitat in which the species occurred. The suitable area of habitat corresponds to the area where populations occur, such as a ravine, an area of woodland, cliff-face or crevice.

The area of occupancy and maximum area figures were based on detailed research, targeted surveys and measurement of all colonies conducted since the 2007–2012 reporting period.

Proximity to a water source, adequate shade/shelter and adequate canopy cover (in woodland locations) are necessary for both generations of *V. speciosa*. In addition to assessing canopy cover, shade (Shade Index) and water source, indicators for assessing the *Habitat for the species* also included substrate moisture and the occurrence of vigorous native species or invasive alien species in association with sporophyte colonies.

Gametophyte-only populations can occur at drier locations than those in which the sporophyte generation typically occurs. A water source is not always visible at gametophyte-only populations. At these drier locations, running water would not always be expected to be observed; however, relative humidity levels should still be comparable with those found at the sporophyte colonies in wetter habitats. Following recommendations from the previous monitoring report (Ní Dhúill *et al.* 2022), the indicator for humidity for this reporting period was *substrate damp/wet to touch*.

A water source is usually clearly visible at populations where sporophytes occur and include rivers, streams, waterfalls, cascades, dripping rock-faces or dripping banks. These water sources are very important in terms of maintaining high relative humidity where *V. speciosa* colonies occur. At sporophyte colonies that occur on river/stream banks, the main source of water for the colonies is typically seepage. These banks are permanently wet, which also aids maintenance of high relative humidity. In cases where a water source is not clearly visible, the substrate upon which *V. speciosa* sporophytes occur should be wet/damp to touch.

Shading at woodland colonies where sporophytes occur is mainly provided by canopy cover. Gametophytes at co-occurring generation or gametophyte-only populations in woodland habitats typically occur in crevices, except in more deeply shaded ravines where gametophytes have been observed growing in large mats on ravine walls (Ní Dhúill, 2014). Canopy cover (Domin scale scores, Table 4, below), which is the estimated proportion of the colony area covered by the vertical projection of the tree canopy, and Shade Index values (as per Table 5, below) were assigned for each colony (with canopy cover measured in woodland populations only). These would be expected to remain relatively stable when compared to baseline data from the previous reporting period.

Table 4 Domin scale, adapted from Kent (2012), used to assess canopy cover at *Vandenboschia speciosa* colonies occurring in woodlands.

Domin scale	Percentage cover
10	91-100%
9	76-90%
8	51-75%
7	34-50%
6	26-33%
5	11-25%
4	5-10%
3	1-4%
2	<1% with several individuals
1	<1% 1-2 individuals, no measurable cover
+	<1% 1 individual with no measurable cover

Table 5 Shade Index values recorded at each *Vandenboschia speciosa* colony monitored in woodland and open upland habitats.

Shade index value	Details
1	Fully exposed to sunlight all day
2	Sunlit for > half the day
3	Significant sunlight, but for < half the day
4	Moderate shade, e.g. light-medium deciduous canopy
5	Permanently shaded from direct sunlight but otherwise open to sky
6	Deep woodland (e.g. broadleaf, coniferous or in ravine) shade
7	Perpetual deep shade, e.g. cave entrance, beneath boulder

2.3.5 Encroachment by invasive non-native and/or vigorous native species

Encroachment of *V. speciosa* sporophyte colonies by vigorous native species or by invasive alien species was investigated at all populations.

Following recommendations in the previous monitoring report (Ní Dhúill *et al.*, 2022; see also Section 1.5.3), the presence of invasive species can be used as an indicator for the *Habitat for the species* parameter rather than simply those invasive species that occur within 1 m of a sporophyte colony, as two of the major problematic invasive species (*Rhododendron ponticum* and *Prunus laurocerasus*) would not occur within a *V. speciosa* sporophyte colony. The target is for no obvious impact on the colony. If the invasive species is providing essential canopy cover, then this would result in a pass for that indicator. However, if a negative impact is observed, such as bank slippage in the vicinity of the sporophyte colony, this would result in a fail for this indicator.

Gametophytes grow in very dark microhabitats where there is little competition from other species and, as such, invasive non-native species or vigorous native species are not regarded as posing a significant threat to this generation at present.

2.3.6 Vegetation plots

Detailed surveying of vegetation was not included in the monitoring of *V. speciosa*. However, for baseline surveys, vegetation relevés were recorded in which all plant species and their percentage cover within a 2 m x 2 m plot centred around the *V. speciosa* colony (or area of the habitat if less than 2 m x 2 m) were recorded in Turboveg CE (Alterra, The Netherlands).

2.3.7 Impacting activities (Pressures and threats)

For Article 17 reporting, pressures are considered to be factors which have acted within the current reporting period (2019–2024) and have an impact on the long-term viability of the species or its habitat(s); whilst threats are factors expected to be acting in the future (in the future two reporting periods, *i.e.* within 12 years following the end of the current reporting period) that are likely to affect the long-term viability of the species and/or its habitat(s) (DG Environment, 2022, 2023). In the guidelines it is understood that a pressure whose impact is described as *ongoing, and in the future* is both a pressure and a threat, and when having an impact *only in the future* is only a threat. Prior to evaluating the *Future prospects* parameter, the activities, both positive and negative, recorded in the current baseline, monitoring, and surveying project were examined.

2.4 Assessments

The data recorded on the Killarney Fern site survey card and monitoring sheet were used to complete an Individual Site Assessment sheet for each surveyed population which comprises the *Population*, *Habitat for the species*, and *Future prospects* assessments, full details of which are set out below. The combined data allow for the conservation status of each population to be determined, whether Favourable, Unfavourable–Inadequate or Unfavourable–Bad. See Appendices 1 and 2 for the updated Killarney Fern site survey card and monitoring sheet which have been updated for ease of completion in the field.

2.4.1 Population assessment for sporophyte populations (with or without gametophytes)

The *Population* assessment for *V. speciosa* was devised by Ní Dhúill *et al.* (2015) and updated for the Article 17 reporting period 2013–2018 (Ní Dhúill *et al.*, 2022; see Tables 6 and 7). The data for completion of the *Population* assessment were derived from the *V. speciosa* monitoring sheets which were completed for each colony. For populations with multiple colonies, the *Population* assessment was based on the combined colony data from each *V. speciosa* monitoring sheet for a given population.

The assessment sheet comprises a number of indicators for assessing the population and a set target for each indicator to determine the conservation status of an individual population. There are two different *Population* assessments depending on whether the population comprises sporophytes (with or without gametophytes) (Table 6) or gametophyte-only populations (Table 7). Sporophytes and gametophytes are measured as separate entities, even when the gametophyte is occurring intermingled with the sporophytes.

Population size was determined based on the number of colonies. For the *Population* assessment, the target is no reduction in colony numbers since the previous reporting period (2013–2018). For the area of occupancy, the target is no more than 10% reduction from the baseline reference value for each sporophyte colony, to allow for human error and recording variability.

One of the indicators is the presence of associated gametophytes, if previously recorded, with the target being that they are present. If gametophytes are not observed at previously co-occurring generation populations, then the result is 'absent' and a fail for this attribute. If there are no gametophytes present in populations previously recorded as sporophyte-only, having conducted a thorough search in the immediate vicinity, the result is 'NA' (not applicable). However, all subsequent visits of sporophyte-only populations must still include a thorough search for gametophytes in the immediate vicinity. For multiple colony populations, the result column for the indicator 'Frond types' states which colonies the frond types refer to, as not all colonies in a population may have fertile fronds. This would follow for the indicators 'Associated gametophytes' and 'Juveniles emerging from gametophytes'. See the example given below in Table 6.

For frond types (described in Section 2.3.2), the target is the presence of mature sterile/fertile fronds and/or young fronds and/or unfurling fronds at colonies where sporophytes occur. Fertile fronds have been included as an indication of colony health, productivity and viability. Fertile fronds have the potential to produce gametophytes which in turn have the potential to produce juvenile sporophytes, which may increase the population size. Mature sterile, young and unfurling fronds also indicate growth by continued production of fronds, as do maturing-juvenile sporophytes. For the purpose of assessing this attribute as an indicator of a healthy viable population, any frond type or combination would be a pass.

For frond numbers, the target is no more than a 10% reduction in numbers for each sporophyte colony, where the reduction is due to an obvious pressure. Due to natural fluctuations in frond numbers, sporophyte colonies failing to reach the frond count target are considered to have failed under the frond count indicator only when there is an obvious pressure to which any frond loss can be attributed. Where a reduction cannot be attributed to an obvious pressure, the indicator should be recorded as passed; this should trigger a follow-up investigation into the cause of the decline and to determine whether or not this is part of a natural fluctuation. This may require more frequent monitoring of any such colonies (initially annually) and should trigger actions to improve the conservation status of the colony. Any colony showing declines in frond numbers over two successive reporting cycles, even if the pressure is undetermined, should be deemed to have failed the frond number indicator. Living frond numbers are reported separately from juvenile fronds.

In the case of juvenile sporophytes emerging from gametophytes (via sexual reproduction/apogamy), their presence or absence should be recorded along with the number of juvenile fronds recorded (counts or estimates). Juvenile sporophyte frond numbers are reported separately as, when present, these numbers may skew the overall figure for frond numbers, as not all juveniles would be expected to survive to reach maturity. It is unknown what the survival rates of juvenile sporophytes are, or the time it takes for them to reach maturity. For juvenile sporophytes, no target value relating to reduction in juvenile frond number is given. However, if there is a reduction in frond numbers and such a reduction cannot be attributed to an obvious pressure, the indicator should be recorded as passed. Conversely, where a reduction is attributable to an obvious pressure then a fail for that indicator will be returned. If juvenile sporophytes emerging from gametophytes were not observed during the previous monitoring period, then NA will be input in the target box; however, if juveniles are observed during the current or future monitoring, the numbers should be counted or estimated as described in Section 2.3.2.

Table 6 shows an example of a completed *Population* assessment for a population (TS11, Co. Kerry) in which sporophytes occur with gametophytes.

The example *Population* assessment shows survey and monitoring results from three reporting periods: 2007–2012, 2013–2018, and 2019–2024, listed in three columns, for comparison. For the 2019–2024 baseline survey populations, there is just one column with results and the conservation status for the population will be Favourable as it is the first time it will have been assessed.

The individual population condition is considered Favourable for populations containing sporophytes (including co-occurring generation populations) if six or more indicators are passed. It is considered Unfavourable–Inadequate if only three to five indicators are passed, and Unfavourable–Bad if zero to two indicators are passed. In cases where the indicator cannot be assessed, a value of NA should be returned, e.g. at colonies where gametophytes and/or juvenile sporophytes were historically absent and continue to be absent. This will equate to a pass for that indicator for the purpose of the target requirements for assessing the population.

Table 6 Population Assessment indicators and targets for *Vandenboschia speciosa* at population TS11, Co. Kerry showing results for previous and current reporting periods. Favourable (Green): 6-7 passes; Unfavourable–Inadequate (Amber): 3-5 passes; Unfavourable–Bad (Red): 0-2 passes.

* NA (not applicable) means that the indicator was not observed during the monitoring periods 2007–2024. ** Although 15% reduction in sporophyte area of occupancy, expert judgement was used to pass this indicator as the colony is looking healthy, there was an increase in frond numbers year-on-year, and no pressures were observed.

Indicator	Target	Result (2007–2012)	Result (2013–2018)	Result (2019–2024)	Pass/Fail (2019–2024)
Total number of colonies (of all generations)	No loss of colonies	1	1	1	Pass
Population size (combined Area of Occupancy of all colonies and generations).	No reduction in population size (area of occupancy) for sporophytes. Expert judgement regarding gametophytes.	0.3 m ²	0.45 m ²	**0.39 m ²	Pass
Maximum area of all gametophyte colonies.	No reduction in maximum gametophyte colony area size	0.0025 m ²	0.003 m ²	0.003 m ²	Pass
Frond types	Mature Sterile/ Fertile and/or Young fronds and/or croziers present	All frond types present	Sterile, Fertile and Young present	Sterile, Fertile and Young present	Pass
Associated gametophytes	No loss of associated gametophyte colonies, if previously observed	Present	Present	Present	Pass
Total number of living fronds (excluding juvenile sporophytes) that may have arisen from gametophytes (counts)	No reduction. If there is a reduction in frond numbers with no obvious pressure attributable to loss, the result is a pass,	35	53	82	Pass
Juveniles emerging from gametophytes: total number of juvenile sporophytes that may have arisen from gametophytes	If there is a reduction in juvenile frond numbers with no obvious pressure attributable to loss, the result is a pass,	*NA	NA	NA	Pass
Individual Population Condition (sporophytes with or without gametophytes)				7 passes	Favourable

2.4.2 Population assessment for gametophyte-only populations

Gametophyte-only *Population* is assessed by combining the monitoring results for all gametophyte colonies within each gametophyte population and completing the *Population* assessment (Table 7). The assessment sheet comprises a number of indicators for assessing the population and a set target for each indicator to determine the conservation status of an individual population.

Population size was determined based on the number of gametophyte colonies. For the *Population* assessment, the target is no reduction in gametophyte colony numbers since the previous reporting period.

As was reported by Ní Dhúill *et al.* (2022) during the last reporting period (2013–2018), estimating an area of occupancy for the gametophyte generation can be difficult, as such estimates can be very subjective. Therefore, expert opinion should be used when determining whether a colony passes or fails on the target for area of occupancy. The maximum area, however, would not be expected to be reduced unless there was some pressure impacting upon it, e.g. landside or bank slippage. For maximum area, the target is no more than 10% reduction from the baseline reference value for each gametophyte colony (see Section 2.3.3 for more details on the gametophyte maximum area).

The individual population condition is considered Favourable for populations containing gametophyte-only if at least three indicators are passed. It is considered Unfavourable–Inadequate if only one or two indicators are passed and Unfavourable–Bad if no indicators are passed. In cases where the indicator cannot be assessed, a value of NA should be returned, e.g. at colonies where juvenile sporophytes were historically absent and continue to be absent. This will equate to a pass for that indicator for the purpose of the target requirements for assessing the population. If juvenile sporophytes are observed at such colonies during future monitoring, they should be recorded, and juvenile frond numbers should be counted or estimated.

Table 7 *Population* Assessment indicators and targets for *Vandenboschia speciosa* at population TS28, Co. Kilkenny, showing results for reporting periods 2007–2012 and 2013–2018*. Favourable (Green): at least 3 passes; Unfavourable–Inadequate (Amber): 1–2 passes; Unfavourable–Bad (Red): 0 passes.

* Population TS28 was not monitored in the 2019–2024 reporting period.

Indicator	Target	Result (2007–2012)	Result (2013–2018)	Pass/Fail (2013–2018)
Total number of colonies	No loss of colonies	2	7	Pass
Population size (combined area of occupancy of colonies)	Expert judgement regarding area of occupancy.	1.23 m ²	1.96 m ²	Pass
Maximum area of all gametophyte colonies	No reduction in maximum size of gametophyte colony area	4.91 m ²	10.29 m ²	Pass
Juveniles emerging from gametophytes	If there is no reduction in juvenile frond numbers, or a reduction but with no obvious pressure attributable to loss, the result is a pass	NA	NA	Pass
Individual Population condition (gametophyte-only)			4 passes	Favourable

2.4.3 *Habitat for the species assessment for sporophyte populations (with or without gametophytes)*

In Ireland, both generations of *V. speciosa* occur in either woodland habitats or open upland habitats. Within these habitats, *V. speciosa* sporophytes and gametophytes occupy specific microhabitats that provide constant high relative humidity and shade.

For woodland habitats, the indicators used are canopy cover, with a pass target of Domin scale ≥ 8 ; shade, with a target of Shade Index value of ≥ 4 ; humidity and substrate moisture, with a target that the substrate is damp/wet to touch; and encroachment of vigorous native species or invasive non-native species, with a target of Domin scale of ≤ 4 .

For open upland habitats, the indicators used are as above excluding the canopy cover indicator. This would be applicable for any exposed habitat where *V. speciosa* occurs such as exposed rock and open lowlands. The encroachment indicator is also excluded at present.

For habitats where the sporophyte generation occurs (with or without the gametophytes), Table 8 gives an example of a completed *Habitat for the species* assessment for woodland habitats and Table 9 gives an example of a completed *Habitat for the species* assessment for open upland habitats.

The individual *Habitat for the species* assessment is considered Favourable for woodland populations containing sporophytes (with or without gametophytes) if three to four indicators are passed. It is considered Unfavourable–Inadequate if only two indicators are passed and Unfavourable–Bad if zero to one indicator is passed.

In addition, following recommendations in the previous monitoring report (Ní Dhúill *et al.*, 2022) and outlined in Section 1.5.3, the presence of invasive alien species and vigorous native species should be used as an indicator for the *Habitat for the species* parameter rather than simply those species that occur within 1 m of a sporophyte colony, as two of the major problematic invasive species (*R. ponticum* and *P. laurocerasus*) would not occur within a *V. speciosa* sporophyte colony. The target is for no obvious impact on the colony. If the invasive alien species or vigorous native species is providing essential canopy cover, then this would result in a pass for that indicator. However, if a negative impact is observed, such as bank slippage in the vicinity of the sporophyte colony, this would result in a fail for this indicator.

Table 8 *Habitat for the species* assessment indicators and targets for woodland populations where sporophytes occur, with or without gametophytes, at *Vandenboschia speciosa* population TS25, Co. Cork showing results for the reporting periods 2007–2012, 2013–2018, 2019–2024. Favourable (Green): 3-4 passes; Unfavourable–Inadequate (Amber): 2 passes; Unfavourable–Bad (Red): 0-1 passes.

* This indicator was previously “encroachment of invasive alien species” using Domin scale to record invasive species within the colony, with the target being a score of <4 (0-10%). This indicator was amended following the previous reporting period (2013–2018) (see Section 1.5.3). The revised target is for no obvious impact on colony. If the invasive alien species or vigorous native species is providing essential canopy cover, then this would result in a pass for that indicator. However, if a negative impact is observed, such as bank slippage in the vicinity of the sporophyte colony, this would result in a fail for this indicator. **These results were based on the previous assessments, however, they reflect an impact on colony TS25.01.02.

Indicator	Target	Result (2007–2012)	Result (2013–2018)	Result (2019–2024)	Pass/Fail (2019–2024)
Canopy cover	≥ 8	9	9 TS25.01.01 8 TS25.01.02	9 TS25.01.01 <i>C. avellana</i> canopy 9 TS25.01.02 <i>R. fruticosus</i> agg. canopy	Pass
Shade (shade index)	≥ 4	4	4 TS25.01.01 3 TS25.01.02 7 TS25.01.03-04	4 TS25.01.01 3 TS25.01.02 7 TS25.01.03-04	Fail
Humidity and substrate moisture	Visible water source and/or substrate damp/wet to touch	Substrate damp/wet to touch	Substrate damp/wet to touch	Substrate damp/wet to touch	Pass
Occurrence of vigorous native species or invasive non-native species within and/or in the vicinity of sporophyte colonies at <i>V. speciosa</i> populations *	No obvious impact on colony	**5 TS25.01.01 9 TS25.01.02 <i>R. fruticosus</i> agg	**6 TS25.01.01 10 TS25.01.02 <i>R. fruticosus</i> agg	Impacting Colony TS25.01.02 <i>R. fruticosus</i> agg	Fail
Habitat condition (woodland)			2 passes	Unfavourable–Inadequate	

For open upland populations containing sporophytes (with or without gametophytes), the individual *Habitat for the species* assessment is considered Favourable if two indicators are passed. It is considered Unfavourable–Inadequate if only one indicator is passed and Unfavourable–Bad if no indicators are passed. See Table 9 below.

Table 9 *Habitat for the species* assessment indicators and targets for *Vandenboschia speciosa* where sporophytes occur, with or without gametophytes, at open upland population TS09, Co. Kerry showing results for the reporting periods 2007–2012, 2013–2018, 2019–2024. Favourable (Green): 2 passes; Unfavourable–Inadequate (Amber): 1 pass; Unfavourable–Bad (Red): 0 passes.

Indicator	Target	Result (2007–2012)	Result (2013–2018)	Result (2019–2024)	Pass/Fail (2019–2024)
Shade (shade index)	≥ 5	5	5 TS09.01.01 & TS09.01.03 7 G-only colonies	5 TS09.01.01 & TS09.01.03 7 G-only colonies	Pass
Humidity and substrate moisture	Visible water source and/or substrate damp/wet to touch	Substrate damp/wet to touch	Substrate damp/wet to touch	Substrate damp/wet to touch	Pass
Habitat condition (open upland)		2 passes		Favourable	

2.4.4 *Habitat for the species* assessment for gametophyte-only populations

For the *Habitat for the species* assessment of *V. speciosa* gametophyte-only populations, there are two attributes that need to be assessed: shade and substrate moisture (Table 10). The target for shade is a Shade Index value of ≥6 and the target for soil moisture is that the substrate is damp/wet to touch.

The individual *Habitat for the species* assessment is considered Favourable for populations containing gametophyte-only if two indicators are passed. It is considered Unfavourable–Inadequate if only one indicator is passed and Unfavourable–Bad if no indicators are passed.

Table 10 *Habitat for the species* assessment indicators and targets for *Vandenboschia speciosa* where gametophytes-only occur at population TS04, Co Wicklow, showing results for the reporting periods 2007–2012 and 2013–2018 [no gametophyte-only populations were monitored in the 2019–2024 reporting period]. Favourable (Green): 2 passes; Unfavourable–Inadequate (Amber): 1 pass; Unfavourable–Bad (Red): 0 passes.

Indicator	Target	Results (2007–2012)	Result (2013–2018)	Pass/Fail (2013–2018)
Shade (shade index)	≥ 6	7	7	Pass
Humidity and substrate moisture	Substrate damp/wet to touch	Substrate damp/wet to touch	Substrate damp/wet to touch	Pass
Habitat condition (open upland)		2 passes		Favourable

2.4.5 Future prospects assessment

As per the EU guidelines, “*Future prospects* should be evaluated by individually assessing the expected future trends and subsequently *Future prospects* of each of the other three parameters (*Range, Population, Habitat of 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 (DG Environment, 2022, 2023). 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, 2023). *Range* is evaluated only at the national level.

Observations made for *Future prospects* have been updated since the last reporting period. When determining *Future prospects*, impacting activities were recorded along with the timing of the impacting activity (this is the time frame it is acting in) and each impacting activity is listed as: *in the past but now suspended due to measures*; *ongoing*; *ongoing and likely to be in the future*; or *only in the future*. Scope is also recorded, i.e. proportion of the population affected, and is evaluated as: *whole* (>90%); *majority* (50-90%); or *minority* (<50%). Influence on the population or *Habitat for the species* is recorded as high, medium or low influence (for the National Conservation Assessment, scope and influence are only reported for *ongoing* and *ongoing and likely to be in the future*; however, for this report, scope, influence and estimated impact have been reported for impacting activities). Any additional activities not in the list of impact codes should be recorded and included as observed.

If there is no significant impact from the activities, *Future prospects* should be assessed as Favourable (green), medium impact should be assessed as Unfavourable–Inadequate (amber) and high impact as Unfavourable–Bad (red). For populations where there is more than one impacting activity recorded, if any of the impacting activities are having a medium impact, the overall *Future prospects* assessment is amber for that population (Table 11). Likewise, if any of the impacting activities are having a high impact on an individual population, the overall *Future prospects* assessment is red for that population. It should be noted in the *Future prospects* assessment if the activity is a pressure (impacting the species or habitat within the current reporting period and impacting on long-term viability of the species or habitat) or if it is a threat (likely to impact the species or habitat within the next two reporting cycles and likely to affect the long-term viability of the species or habitat). Threats should reflect issues judged to be reasonably likely and not theoretical threats. For multiple-colony populations, if any colony within a population has an Unfavourable Conservation Status, then the whole population is assigned an Unfavourable Conservation Status.

Table 11 *Future prospects* assessment of impacting activities for *Vandenboschia speciosa* population TS14, Co. Kerry (2019–2024) indicating pressure or threat, the timing (time frame it acted in), scope (proportion of the population affected), influence on the population or Habitat for the species, and estimated impact. Favourable (Green): No significant impact; Unfavourable–Inadequate (Amber): Any medium impact; Unfavourable–Bad (Red): Any high impact.

Code	Pressure/ Threat	Timing	Scope	Influence	Estimated impact
PI03 (Problematic native species)	Pressure	Ongoing	minority <50%	Medium (TS14.01.01)	Medium
PM05 (Avalanches, landslides and collapse of terrain)	Pressure	Ongoing	minority <50%	Low (TS14.01.01)	Low
Future prospects status			Unfavourable-Inadequate		

Set out below in Table 12 by way of example are proposed conservation measures to be implemented to address impacting activities where necessary at population TS14, Co. Kerry.

Table 12 Proposed conservation measures (using updated EU codes for reporting period 2019–2024) for *Vandenboschia speciosa* population TS14, Co. Kerry, arising from *Future prospects* assessment of impacting activities.

Measure from list	Extent	Explanation
MI05 Management of problematic native species	Colony TS14.01.01	Two native species have become problematic at this colony (<i>Hedera hibernica</i> and <i>Saxifraga hirsuta</i>). These species are growing over the fronds and putting weight on the colony with many dead fronds beneath. Without sufficient canopy cover above the colony, these problematic native species will continue to impact this colony.

2.4.6 Overall conservation assessment for *Vandenboschia speciosa* in Ireland

The framework for assessing the conservation status at the individual population level allows for the amalgamation of results to assess conservation status at a national level, as required under Article 17 of the Habitats Directive. Expert judgement should be used when assessing attributes at each population, *i.e.* where there is a localised issue that is not regarded as a threat at the national level, this threat should be highlighted for that population, but it may not necessarily reflect a negative impact on the national conservation status.

The overall Conservation Status Assessment for the Irish *V. speciosa* meta-population was made, utilising the survey results for the three parameters *Population*, *Habitat for the species* and *Future prospects* and following the guidance provided by the EU (DG Environment, 2022, 2023) and criteria developed specifically for *V. speciosa* (Table 13). Expert judgement was exercised throughout the assessment process, in particular to take account of recording variability and the evaluation of natural/other processes.

Table 13 Assessing Overall Conservation Status for *Vandenboschia speciosa* in Ireland.

* For reasons other than natural frond turnover or other natural processes.

** Number from fronds recorded in 2019–2024 reporting period (see Sections 3.1.4 and 3.2.1 tables).

Favourable (green)	Area of occupancy of population stable or above 'Favourable Reference Population' OR number of fronds stable, increasing or if declining* then by not more than 10% below that recorded in previous reporting period** (any decline attributable to natural frond turnover is acceptable).
Unfavourable–Inadequate (amber)	Decline* in area of occupancy of population of up to 25% below 'Favourable Reference Population' OR decline* in number of fronds of 11-25% below the number recorded in the previous reporting period**.
Unfavourable–Bad (red)	Decline* in area of occupancy of population of more than 25% below 'Favourable Reference Population' OR decline* in number of fronds of more than 25% below the number recorded in the previous reporting period**.

3 Results

3.1 Overall statistics

This current report takes account of the data collected over the last three reporting periods (18 years). Table 14 shows a summary of comparisons between each reporting period, including number of populations, number of colonies, number of colonies declared extinct during that period, area of occupancy, maximum area, number of monitored populations with a Favourable or Unfavourable conservation assessment, and the national overall conservation trend.

Table 14 Record numbers for populations and colonies of *Vandenboschia speciosa* over the last three reporting periods (18 years) including any losses during that period, area of occupancy (m²), maximum area (m²), number of monitored populations with an overall Favourable Conservation Status, and Unfavourable–Inadequate (U–I) Conservation Status and the national overall conservation trend.

* The apparent reduction in area of occupancy of 15% does not reflect a significant loss in area, but rather is due to the accurate measurements of previously un-monitored colonies and the use of the revised assigned areas for unsurveyed colonies (Ní Dhúill et al., 2022).

** TS20.04.01 (Co. Limerick); TS22.01.07 (Co. Cork). Plus pre–1960, declared extinct in 2013–2018: TS06.02.03, TS50.01.01, TS51.01.01, TS51.02.01 (all Co. Kerry).

*** TS26.01.13 (Co. Waterford) was merged into TS26.01.12, as both colonies have grown together.

Reporting period	No. populations monitored	No. colonies monitored	Overall no. extant populations	Overall. extant colonies	No. colonies declared extinct since the EU Habitats Directive came into force	Monitored colonies Area of Occupancy (m ²)	Monitored colonies Maximum Area (m ²)	No. monitored populations with Favourable Conservation Status	No. monitored populations with U–I Conservation Status	National Overall Conservation Trend
2007–2012	27	79	84	177	1	280	449	22	5	Stable
2013–2018	40	198	86	290	**6	*239	695	33	7	Stable
2019–2024	49	284	136	501	***1	288	812	43	6	Stable

3.1.1 Number of *Vandenboschia speciosa* populations nationally

There are currently 136 known extant *V. speciosa* populations in Ireland comprising 501 colonies. The population types and numbers of each are set out in Table 15. The definitions of 'colony' for both generations are given in Section 1.1.3. For the previous reporting period (2013–2018), 86 populations comprising 290 colonies were recorded. Therefore, an additional 50 populations have been added to the national number of population records for *V. speciosa* for the current reporting period, an increase of 58%.

Of these 50 additional populations, 36 occur within 22 new 10 km x 10 km Irish National Grid squares, thus increasing the distribution of the species from 5,600 km² in 2018 to 7,800 km² in 2024 (39% increase) (Figure 10) [note that the 2018 figure was erroneously reported as 5,700 km² in NPWS (2019) and Ní Dhúill *et al.* (2022), it being thought that the species had been recorded in 57 10 km grid squares rather than 56]. This increased the range of the species from 10,100 km² in 2018 to 13,500 km² in 2024 (Figure 10). These 36 populations comprise 57 colonies, of which nine are sporophyte-only, three are sporophyte and gametophyte co-occurring, one colony has juveniles emerging from gametophyte, and 44 colonies are gametophyte-only.

Table 15 Summary of *Vandenboschia speciosa* generations at all currently known extant populations showing the numbers and percentages of the different population/colony types for reporting period 2019–2024. Figures include populations monitored during the current project and populations that were not monitored or surveyed.

Colony Type	No. of populations	% of total population	No. colonies	% of total colonies
Sporophytes and gametophytes co-occurring (SG)	27	20%	57	11%
Sporophytes, gametophytes and juvenile sporophytes co-occurring (SGJ)	19	14%	63	12%
Sporophyte-only (S)	17	12%	81	16%
Gametophyte-only (G)	72	53%	285	57%
Gametophytes and juvenile sporophytes (GJ)	1	1%	13	3%
Mature sporophytes with juveniles (without gametophytes observed) (SJ)	0	0%	2	1%
Total extant <i>V. speciosa</i> populations & colonies	136		501	

In the previous reporting period (2013–2018), 86 populations comprising 290 colonies were recorded nationally. Since that period:

- At population TS01, Co Tipperary and Limerick, juvenile sporophytes were not re-found during the current reporting period at colony TS01.03.04. This colony has been updated to gametophyte-only.
- At population TS21, Co. Donegal, a record from 1993 was provided to the NPWS for a gametophyte-only colony in a deep crevice in a rocky cleft by the road. For the current reporting period, the surveyors were unable to locate this colony. The habitat was unsuitable (too dry and calcareous). It may be that there was an error in the grid reference.
- At population TS26, Co. Waterford, two colonies (TS26.01.12 and TS26.01.13) have grown together and are no longer distinguishable as two separate colonies. They have

been merged into one colony TS26.01.12, thus reducing by one the overall number of colonies at this population, although not a genuine loss. Note that an additional 10 colonies were recorded at this population.

- One population at TS49, Co. Kerry was originally recorded as a sporophyte-only population with a single colony. However, when visited for baseline surveying, young and juvenile sporophytes emerging from gametophytes were recorded at three colonies and two gametophyte-only colonies were also recorded.
- Population TS53, Co. Kerry was originally recorded as a sporophyte and gametophyte co-occurring population. However, when visited for baseline surveying, the mature sporophyte colony was not found, but it is not considered extinct. The previously recorded gametophyte-only colony within this population was re-found along with an additional two gametophyte-only colonies, plus a colony with juvenile sporophytes emerging from gametophytes. The population has been recorded as gametophytes and juvenile sporophytes co-occurring (GJ) for the report on monitored populations.
- One record from 2016 that was provided to the NPWS as a G-only population in Co. Wexford (TS77) and was included in the baseline survey was found to have young and juvenile sporophytes emerging from gametophytes when surveyed. This is a first record for sporophytes in Co. Wexford.
- New populations were also recorded in Co. Clare in the last number of years (2020–2024) with 26 new populations comprising 43 colonies, including one sporophyte population that was last recorded in 1879 (TS125) (Ó Catháin, 2024). The majority of these new populations in Co. Clare were gametophyte-only (21 populations comprising 33 colonies). There were three sporophyte-only populations and two sporophyte and gametophyte co-occurring populations.

3.1.2 Number of *Vandenboschia speciosa* populations monitored and surveyed

For the current reporting period (2019–2024), 50 populations were scheduled for visiting. One population was not found (TS45, Donegal), however, it is not considered extinct. Therefore, a total of 49 populations comprising 284 colonies were surveyed.

Of these 49 populations, 20 had previously been surveyed in 2013–2018. When monitored in the current reporting period (2019–2024), 159 colonies were recorded at those 20 populations, of which 31 were new colonies, recorded across six populations (TS09, TS15, TS25, Co Kerry; TS22, TS30, Co. Cork; and TS26, Co. Waterford).

At these six populations, the majority of new records were for colonies with mature and juvenile sporophytes and gametophytes co-occurring (SGJ; 11 colonies), 10 colonies were sporophyte-only (S), three were sporophyte and gametophyte co-occurring (SG), four were gametophyte-only (G), one colony was mature and juvenile sporophytes co-occurring (SJ), and two were colonies that had juvenile sporophytes emerging from gametophytes (GJ).

For populations where juvenile sporophytes emerging from gametophytes occurred, there was an increase in the number of such populations since the last reporting period, occurring at 19 such populations in 2019–2024 compared to 12 in 2013–2018, which is a 58% increase between the current and previous reporting periods. The recording of additional juvenile sporophytes is, in part, the result of targeted surveying, improved knowledge and more accurate data. Table 16 sets out the summary of *V. speciosa* generations surveyed during the current reporting period showing the number of population and colony types. Table 17 provides details of 49 populations including the county, number of monitored colonies per population, generation at population, generation at colony (SG; SGJ; S; G; GJ; SJ); number of colonies of each generation, and number of colonies with fertile fronds and juvenile fronds. Abbreviations for colony types are as given in Table 1.

Table 16 Summary of *Vandenboschia speciosa* generations at the 49 populations monitored and surveyed during reporting period 2019–2024 showing numbers and percentages of the different population/colony types.

Colony Type	No. of populations	% of total population	No. colonies	% of total colonies
Sporophytes and gametophytes co-occurring (SG)	17	35%	42	15%
Sporophytes, gametophytes and juvenile sporophytes co-occurring (SGJ)	17	35%	57	20%
Sporophyte-only (S)	4	8%	38	13%
Mature sporophytes with juveniles (without gametophytes observed) (SJ)	0	0%	3	1%
Gametophytes and juvenile sporophytes (GJ)	2	4%	11	4%
Gametophyte-only (G)	9	18%	133	47%
Total extant <i>V. speciosa</i> populations & colonies	49	100%	284	100%

Table 17 Details of 49 *Vandenboschia speciosa* populations monitored during 2019–2024: population code, county, number of monitored colonies per population, summary of colony types (Gen. = generation: SG; SGJ; S; SJ; GJ; G) at each population, number of colonies of each generation at population, number of colonies with fertile fronds and number with juvenile fronds. Abbreviations for colony types are as given in Table 1.

* Previously GJ at TS01.03.04 (2013–2018). Juveniles not re-found. No obvious pressure.

Pop. code	County	No. colonies monitored	Gen. at pop.	SG	SGJ	SJ	S	GJ	G	No. fertile colonies	No. juvenile colonies
TS01	Tipperary/Limerick	11	*SG	2	0	0	0	0	9	0	0
TS05	Kerry	2	S	0	0	0	2	0	0	1	0
TS07	Carlow	2	SGJ	0	1	0	0	0	1	1	1
TS08	Cork	3	SG	2	0	0	0	0	1	2	0
TS09	Kerry	4	SG	1	0	0	1	0	2	0	0
TS10	Kerry	2	SG	1	0	0	0	0	1	1	0
TS11	Kerry	1	SG	1	0	0	0	0	0	1	0
TS13	Kerry	1	SGJ	0	1	0	0	0	0	0	1
TS14	Kerry	2	SGJ	1	1	0	0	0	0	0	1
TS15	Kerry	6	SGJ	0	1	0	3	0	2	0	1
TS16	Limerick	5	SG	1	0	0	0	0	4	1	0
TS17	Sligo	2	SG	1	0	0	0	0	1	0	0
TS19	Kerry	2	SG	1	0	0	0	0	1	1	0
TS20	Limerick	7	SG	4	0	0	0	0	3	3	0
TS21	Donegal	5	SG	1	0	0	0	0	4	0	0
TS22	Cork	11	SGJ	3	7	0	0	1	0	1	7
TS23	Donegal	1	SG	1	0	0	0	0	0	0	0

Pop. code	County	No. colonies monitored	Gen. at pop.	SG	SGJ	SJ	S	GJ	G	No. fertile colonies	No. juvenile colonies
TS24	Kerry	31	SGJ	4	21	0	2	3	1	1	24
TS25	Cork	4	SG	1	0	0	1	0	2	2	0
TS26	Waterford	49	SGJ	13	11	2	16	1	6	4	14
TS30	Cork	9	SGJ	1	1	1	4	0	2	0	2
TS32	Kerry	1	S	0	0	0	1	0	0	0	0
TS36	Kerry	2	G	0	0	0	0	0	2	0	0
TS40	Kerry	2	S	0	0	0	2	0	0	0	0
TS43	Waterford	4	SGJ	0	1	0	0	0	3	1	1
TS44	Cork	6	SG	1	0	0	1	0	4	0	0
TS48	Kerry	1	SG	1	0	0	0	0	0	0	0
TS49	Kerry	5	SGJ	0	3	0	0	0	2	0	3
TS53	Kerry	5	GJ	0	0	0	0	1	4	0	1
TS54	Kerry	2	SG	0	0	0	1	0	1	0	0
TS56	Wicklow	9	G	0	0	0	0	0	9	0	0
TS58	Kerry	6	G	0	0	0	0	0	6	0	0
TS59	Kerry	5	S	0	0	0	3	0	2	0	0
TS62	Waterford	11	G	0	0	0	0	0	11	0	0
TS63	Waterford	9	G	0	0	0	0	0	9	0	0
TS64	Kerry	1	S	0	0	0	1	0	0	0	0
TS66	Kerry	1	SG	1	0	0	0	0	0	1	0
TS67	Cork	1	SGJ	0	1	0	0	0	0	0	1
TS68	Cork	1	SGJ	0	1	0	0	0	0	0	1
TS69	Kerry	2	SGJ	0	1	0	0	0	1	0	1
TS71	Kerry	3	GJ	0	0	0	0	2	1	0	2
TS72	Kerry	9	SGJ	0	1	0	0	1	7	0	2
TS73	Kerry	1	G	0	0	0	0	0	1	0	0
TS77	Wexford	10	SGJ	0	3	0	0	2	5	0	5
TS78	Cork	11	SGJ	0	1	0	0	0	10	0	1
TS79	Kerry	2	G	0	0	0	0	0	2	0	0
TS80	Cavan	7	G	0	0	0	0	0	7	0	0
TS81	Kerry	5	SGJ	0	1	0	0	0	4	0	1
TS85	Kerry	2	G	0	0	0	0	0	2	0	0
		284		42	57	3	38	11	133	21	70

3.1.3 Frond counts and estimates

Frond numbers can fluctuate on an annual basis; therefore, presence or absence of a colony is a more reliable unit than frond numbers. Notwithstanding this, recording the number of fronds in individual colonies during monitoring surveys does provide useful information on the status of the colonies over the long term. Frond numbers were recorded at each colony following the methods described in Section 2.3.2. Table 18 shows details of numbers and types of colonies, frond types and frond numbers for the 49 *V. speciosa* populations monitored and surveyed. This table also includes results for the area of occupancy and maximum area of each population.

Table 18 Details of 49 *Vandenboschia speciosa* populations monitored 2019–2024. Number of colonies per population (No. cols), summary of colony types (Gen. = generation) at each population, total number of living fronds excluding juveniles (juv.), total number of juvenile fronds, total number of maturing-juveniles, total number of fertile fronds, total area of occupancy (AoO) (m²) and maximum (max) area for sporophytes (S) and for gametophytes (G) (m²). The results are based on monitored populations and do not include assigned areas for any colonies not located during the 2019–2024 reporting period. Figures rounded up to two decimal places where possible.

Pop. code	County	No. cols	Gen.	Living fronds (ex. juv.)	Total juv. frond count	Total maturing juv. fronds	Fertile frond count	S AoO m ²	S max area m ²	G AoO m ²	G max area m ²
TS01	Tipperary/Limerick	11	SG	1749	0	0	0	4.52	9.99	1.91	13.20
TS05	Kerry	2	S	1059	0	0	245	2.09	3.01	0.00	0.00
TS07	Carlow	2	SGJ	59	2	16	24	0.38	0.78	1.59	5.90
TS08	Cork	3	SG	2575	0	0	804	7.23	32.88	0.12	0.62
TS09	Kerry	4	SG	228	0	0	0	1.61	1.68	0.02	0.17
TS10	Kerry	2	SG	25	0	0	4	0.05	0.18	0.57	1.80
TS11	Kerry	1	SG	82	0	0	2	0.39	0.56	0.00	0.00
TS13	Kerry	1	SGJ	25	26	15	0	0.02	0.23	0.31	0.77
TS14	Kerry	2	SGJ	1074	249	10	0	4.06	7.08	0.76	9.10
TS15	Kerry	6	SGJ	239	3	3	0	0.90	1.93	0.91	4.56
TS16	Limerick	5	SG	1075	0	0	450	2.22	5.56	0.06	0.56
TS17	Sligo	2	SG	80	0	0	0	0.18	0.46	0.02	0.04
TS19	Kerry	2	SG	39	0	0	2	0.13	0.17	0.01	0.51
TS20	Limerick	7	SG	295	0	0	43	2.02	3.06	1.58	5.89
TS21	Donegal	5	SG	233	0	0	0	0.74	1.06	0.07	0.88
TS22	Cork	11	SGJ	3124	79	44	225	9.76	17.30	1.15	9.09
TS23	Donegal	1	SG	38	0	2	0	0.07	0.09	0.02	0.24
TS24	Kerry	31	SGJ	1470	1246	251	107	4.34	13.40	9.01	57.48
TS25	Cork	4	SG	3373	0	0	834	14.28	61.12	0.24	0.58
TS26	Waterford	49	SGJ	43219	349	74	1441	164.89	318.42	29.82	120.05
TS30	Cork	9	SGJ	1632	49	13	0	2.89	5.25	0.11	0.98
TS32	Kerry	1	S	300	0	0	0	0.81	1.25	0.00	0.00
TS36	Kerry	2	G	0	0	0	0	0.00	0.00	0.01	0.10
TS40	Kerry	2	S	141	0	0	0	0.32	1.54	0.00	0.00
TS43	Waterford	4	SGJ	168	9	0	30	0.81	2.70	1.54	17.52
TS44	Cork	6	SG	22	0	0	0	0.06	0.06	0.06	0.42
TS48	Kerry	1	SG	372	0	13	0	0.83	1.66	0.04	0.70
TS49	Kerry	5	SGJ	42	45	14	0	0.03	0.04	0.16	1.90
TS53	Kerry	5	GJ	0	7	0	0	0.00	0.00	0.05	0.34
TS54	Kerry	2	SG	75	0	0	0	0.07	0.12	0.05	0.18
TS56	Wicklow	9	G	0	0	0	0	0.00	0.00	0.57	8.27
TS58	Kerry	6	G	0	0	0	0	0.00	0.00	0.45	1.00
TS59	Kerry	5	S	755	0	0	0	1.44	3.44	0.01	0.01
TS62	Waterford	11	G	0	0	0	0	0.00	0.00	0.71	2.95
TS63	Waterford	9	G	0	0	0	0	0.00	0.00	0.35	4.73
TS64	Kerry	1	S	100	0	0	0	0.15	0.21	0.00	0.00

Pop. code	County	No. cols	Gen.	Living fronds (ex. juv.)	Total juv. frond count	Total maturing juv. fronds	Fertile frond count	S AoO m ²	S max area m ²	G AoO m ²	G max area m ²
TS66	Kerry	1	SG	193	0	0	2	0.42	1.68	0.00	0.03
TS67	Cork	1	SGJ	40	21	30	0	0.08	1.71	0.96	2.40
TS68	Cork	1	SGJ	37	5	0	0	0.09	0.55	0.00	0.05
TS69	Kerry	2	SGJ	41	20	9	0	0.07	0.10	0.13	2.53
TS71	Kerry	3	GJ	0	6	0	0	0.00	0.00	1.08	1.92
TS72	Kerry	9	SGJ	11	17	0	0	0.06	0.11	0.65	4.64
TS73	Kerry	1	G	0	0	0	0	0.00	0.00	0.004	0.02
TS77	Wexford	10	SGJ	32	641	32	0	0.26	4.40	2.18	12.21
TS78	Cork	11	SGJ	26	7	0	0	0.12	0.19	0.46	2.65
TS79	Kerry	2	G	0	0	0	0	0.00	0.00	0.32	3.06
TS80	Cavan	7	G	0	0	0	0	0.00	0.00	0.78	3.03
TS81	Kerry	5	SGJ	20	4	0	0	0.03	0.03	0.09	1.96
TS85	Kerry	2	G	0	0	0	0	0.00	0.00	0.38	3.12
		284		64,068	2,785	526	4,212	228.42	504.00	59.32	308.14

As noted above, during the previous reporting period (2013–2018), juvenile sporophytes were recorded at 12 of the 40 monitored populations (30%) (Table 19). During the current reporting period, juvenile sporophytes were recorded at 19 of the 49 monitored populations, which reflects an increase of 58% in recording of juvenile sporophytes at populations where either generation of *V. speciosa* occurs.

During the previous reporting period, 11 of the 30 monitored populations where mature sporophytes occurred were fertile (37%) (Table 19). In the current reporting period, 14 of the 38 monitored populations where sporophytes occurred were fertile (37%) which represents a 27% increase in populations where fertile colonies occur.

Table 19 Results for monitored *Vandenboschia speciosa* populations where juvenile sporophyte populations and fertile populations were recorded between the previous two surveys and the current (2019–2024) survey, showing percentage (%) differences between each reporting period.

Year	JUVENILE SPOROPHYTES			SPOROPHYTE FERTILITY		
	Total populations monitored	Number of populations with juveniles	% populations with juveniles	Total populations with mature sporophytes	Number of populations with fertile fronds	% populations with fertile fronds
2007–2012	27	5	19%	23	13	57%
2013–2018	40	12	30%	30	11	37%
2019–2024	49	19	39%	38	14	37%

Two colonies that were fertile in the previous reporting period are no longer fertile (TS14.01.01 and TS15.01.01, Co. Kerry). There were four colonies at which fertile fronds were recorded that were not fertile during the previous reporting period: TS07.01.01, Co. Carlow; TS10.01.01, TS19.01.01 (which was fertile in the reporting period 2007–2012) and TS24.01.16, Co. Kerry. Fluctuation in fertility is not considered problematic and likely represents natural turnover of fertile fronds.

In addition, 50 colonies surveyed at 14 populations were recorded as having maturing-juvenile sporophytes (TS07, Co. Carlow; TS23, Co. Donegal; TS22; TS30, and TS67, Co. Cork; TS13, TS14, TS15, TS24, TS48, TS49, TS69, Co. Kerry; TS26, Co. Waterford; and TS77, Co. Wexford). The majority of such colonies occurred at the two largest populations in Ireland (19 at TS24, Co. Kerry and 10 at TS26, Co. Waterford).

3.1.4 Area of occupancy (AoO) and maximum area for both generations

In addition to using colony numbers to determine population size, measures of area of occupancy and maximum area (m^2) parameters were also used. For the 136 known *V. speciosa* populations nationally, the area of occupancy and maximum area figures are based on detailed research, targeted surveys and measurement of all colonies conducted in the reporting periods 2007–2012, 2013–2018 and 2019–2024, data from Ph.D. research into the Irish *V. speciosa* populations (Ní Dhúill, 2014), historic records held by NPWS, and information from NPWS permanent/contract staff and other sources. In order to derive a national area of occupancy for the National Conservation Status Assessment, colony records where there was no information on area were assigned a minimum area of 0.22 m^2 for sporophyte colonies and 0.12 m^2 for gametophyte colonies. Where photographs were available, an estimate was made on colony size where possible. For the National Conservation Status Assessment, the method used to derive the assigned areas is described in Appendix 3.

The derived area of occupancy for the previous reporting period for all 86 *V. speciosa* populations was 239 m^2 with a maximum area of 695 m^2 . For the current reporting period, the derived area of occupancy is 340 m^2 with a maximum area of 962 m^2 . This represents a significant increase in the population size as measured by area of occupancy and maximum areas (42% and 38% increases respectively) and is a reflection of the significant number of new colonies recorded since the last reporting period.

The above figures relate to the overall *V. speciosa* population area based on monitored and unmonitored populations for the purpose of the National Conservation Status Assessment. Favourable population size is deemed to be approximately equal to the current number of colonies (501) and area of occupancy (340 m^2) with a maximum area of 962 m^2 . The current population size is considered to be large enough to allow the long-term survival of this species.

In this updated monitoring manual, the results from the 'Baseline and monitoring surveys of selected populations of *Vandenboschia speciosa* in Ireland, 2021–2024' project relate to monitored colonies only and do not include any assigned areas of occupancy for either generation. Table 20 sets out results for area of occupancy and maximum area of both generations for the 20 populations monitored during the previous survey compared to results for the same 20 populations monitored as part of the 2019–2024 survey. Results for the area of occupancy and maximum area for each of the 49 individual populations monitored in the 2019–2024 survey can be seen in Table 7.

Details of frond numbers recorded, area of occupancy and maximum area at the 20 populations monitored in the previous survey (2013–2018) compared with the same 20 monitored in the current reporting period are shown in Table 20.

Table 20 Comparison of 20 *Vandenboschia speciosa* populations monitored in reporting period 2013–2018 and 2019–2024 showing total number of colonies, living frond numbers, with areas of occupancy (AoO) (m²) and maximum (Max) areas (m²) for both generations (S: sporophyte; G: gametophyte).

COMPARISON BETWEEN THE PREVIOUS AND CURRENT SURVEYS FOR THE SAME 20 POPULATIONS							
Year	No. pops	No. colonies	No. living fronds	AoO m ² S	Max area m ² S	AoO m ² G	Max area m ² G
2013–2018	20	128	44,171	165	378	35	179
2019–2024 (same 20 populations monitored in 2013–2018)	20	159	61,668	223	484	48	232
% increase		24%	40%	35%	28%	37%	30%
No. increase		31	17,497	58	106	13	53

3.2 Assessment

3.2.1 Population assessment

Thirty-nine populations were comprised of multiple colonies, ranging from two to 49. Ten populations comprised a single colony. For the *Population* assessment, if any single colony within a population fails for any indicator, then the whole population fails for that indicator; however, expert judgement should be used for failing whole populations. See Sections 2.4.1 and 2.4.2 for the indicators and targets for assessing the *Population* parameter for the different generations.

Table 21 shows the *Population* assessment for each *V. speciosa* population, showing results for colony numbers, living frond numbers, combined area of occupancy (AoO) and maximum gametophyte area for the current reporting period. For baseline surveys, the Conservation Status for *Population* is Favourable as there is no comparison with the previous reporting period, unless there is an obvious pressure.

Table 21 *Population* assessment for each monitored population showing results for colony numbers, living frond numbers (excluding juveniles) and area of occupancy (AoO) for the 2013–2018 and 2019–2024 reporting periods (rounded up to two decimal places, except for some G colonies that are three decimal places). The overall Conservation Status Assessment for each population for 2019–2024 is set out. The asterisks * and ** relate to results that appear to be Favourable/Unfavourable respectively and for which explanatory notes are provided in the section below the table. Gen. = generations; na = not assessed.

Pop. code	County	Gen.	No. cols. 2013–2018	No. cols. 2019–2024	Total living fronds 2013–2018	Total living fronds 2019–2024	Total AoO 2013–2018	Total AoO 2019–2024	Total max Gam. 2013–2018	Total max Gam. 2019–2024	Conservation Status
TS01	Tipperary/ Limerick	SG	11	11	2,233	1749	7.11	*6.43	10.89	13.20	Favourable
TS05	Kerry	S	1	2	145	1059	1.33	2.09	0.00	0.00	Favourable
TS07	Carlow	SGJ	2	2	51	59	1.93	1.97	3.18	5.90	Favourable
TS08	Cork	SG	3	3	1,953	2575	6.33	7.35	0.29	0.62	Favourable
TS09	Kerry	SG	3	4	237	228	1.82	*1.63	1.22	0.17	Favourable
TS10	Kerry	SG	2	2	51	25	1.15	**0.62	2.30	**1.80	Unfavourable-inadequate
TS11	Kerry	SG	1	1	53	82	0.45	0.39	0.003	0.00	Favourable
TS13	Kerry	SGJ	na	1	na	25	na	0.33	na	0.77	Favourable
TS14	Kerry	SGJ	2	2	1,808	1074	5.36	**4.82	7.08	9.10	Unfavourable-inadequate
TS15	Kerry	SGJ	3	6	223	239	0.81	1.82	0.71	4.56	Favourable
TS16	Limerick	SG	3	5	649	1075	1.68	2.28	0.49	0.56	Favourable
TS17	Sligo	SG	2	2	61	80	0.22	0.20	0.03	0.04	Favourable
TS19	Kerry	SG	2	2	36	39	0.10	0.14	0.54	0.51	Favourable
TS20	Limerick	SG	7	7	230	295	2.78	3.60	4.56	5.89	Favourable
TS21	Donegal	SG	5	5	221	233	0.58	0.81	0.47	0.88	Favourable

Pop. code	County	Gen.	No. cols. 2013–2018	No. cols. 2019–2024	Total living fronds 2013–2018	Total living fronds 2019–2024	Total AoO 2013–2018	Total AoO 2019–2024	Total max Gam. 2013–2018	Total max Gam. 2019–2024	Conservation Status
TS22	Cork	SGJ	7	11	2,493	3124	10.64	10.90	**7.89	9.09	Unfavourable-inadequate
TS23	Donegal	SG	1	1	43	38	0.11	*0.10	*0.05	0.24	Favourable
TS24	Kerry	SGJ	22	31	668	1470	10.91	13.35	45.77	57.48	Favourable
TS25	Cork	SG	4	4	3,085	3373	16.80	**14.52	*1.67	0.58	Unfavourable-inadequate
TS26	Waterford	SGJ	39	49	29,683	43,219	129.24	194.72	**91.03	120.05	Unfavourable-inadequate
TS30	Cork	SGJ	4	9	247	1632	0.93	3.00	0.34	0.98	Favourable
TS32	Kerry	S	na	1	na	300	na	0.81	na	0.00	Favourable
TS36	Kerry	G	na	2	na	0	na	0.01	na	0.10	Favourable
TS40	Kerry	S	na	2	na	141	na	0.32	na	0.00	Favourable
TS43	Waterford	SGJ	na	4	na	168	na	2.35	na	17.52	Favourable
TS44	Cork	SG	na	6	na	22	na	0.11	na	0.42	Favourable
TS48	Kerry	SG	na	1	na	372	na	0.87	na	0.70	Favourable
TS49	Kerry	SGJ	na	5	na	42	na	0.20	na	1.97	Favourable
TS53	Kerry	GJ	na	5	na	na	na	0.05	na	0.34	Favourable
TS54	Kerry	SG	na	2	na	75	na	0.13	na	0.18	Favourable
TS56	Wicklow	G	na	9	na	0	na	0.57	na	8.27	Favourable
TS58	Kerry	G	na	6	na	0	na	0.45	na	1.00	Favourable
TS59	Kerry	S	na	5	na	755	na	1.44	na	0.01	Favourable
TS62	Waterford	G	na	11	na	0	na	0.71	na	2.95	Favourable
TS63	Waterford	G	na	9	na	0	na	0.35	na	4.73	Favourable
TS64	Kerry	S	na	1	na	100	na	0.15	na	0.00	Favourable

Pop. code	County	Gen.	No. cols. 2013–2018	No. cols. 2019–2024	Total living fronds 2013–2018	Total living fronds 2019–2024	Total AoO 2013–2018	Total AoO 2019–2024	Total max Gam. 2013–2018	Total max Gam. 2019–2024	Conservation Status
TS66	Kerry	SG	na	1	na	193	na	0.42	na	0.03	Favourable
TS67	Cork	SGJ	na	1	na	40	na	1.04	na	2.40	Favourable
TS68	Cork	SGJ	na	1	na	37	na	0.09	na	0.05	Favourable
TS69	Kerry	SGJ	na	2	na	41	na	0.20	na	2.53	Favourable
TS71	Kerry	GJ	na	3	na	0	na	1.08	na	1.92	Favourable
TS72	Kerry	SGJ	na	9	na	11	na	0.70	na	4.64	Favourable
TS73	Kerry	G	na	1	na	0	na	0.004	na	0.02	Favourable
TS77	Wexford	SGJ	na	10	na	32	na	2.44	na	12.21	Favourable
TS78	Cork	SGJ	na	11	na	26	na	0.58	na	2.65	Favourable
TS79	Kerry	G	na	2	na	0	na	0.32	na	3.06	Favourable
TS80	Cavan	G	na	7	na	0	na	0.78	na	3.03	Favourable
TS81	Kerry	SGJ	na	5	na	20	na	0.12	na	1.96	Favourable
TS85	Kerry	G	na	2	na	0	na	0.38	na	3.12	Favourable

Below are explanatory notes for the Favourable Conservation Status of populations where there was an apparent reduction in living frond numbers and/or areas of occupancy and/or maximum gametophyte area since the last reporting period. These populations have been highlighted in Table 21 with a single asterisk. Populations with an Unfavourable Conservation Status are highlighted with a double asterisk, with an explanation below.

***Unfavourable result, overall Conservation Status Assessment Favourable**

Population TS01, Co. Tipperary and Limerick

- TS01.01.01. Reduction in estimated number of living fronds by 23% between the previous and current reporting periods (from 2,117 to 1,623 fronds). This is most likely due to natural turnover. Dead fronds are not included in the overall number of living fronds reported. However, when taking into account the number of dead fronds (335), young expanding fronds (216) and croziers (76), and the general appearance of the colony, it is considered to be in good health, thus returning a Favourable Conservation Status for this population. It should also be noted that this is a difficult colony to access as the ledge is narrow and located beneath a flowing waterfall, keeping this colony well hidden.
- TS01.02.02. There was a reduction of 67% in the maximum area of this gametophyte colony; however, this is a very small colony, with a difference in area of occupancy (AoO) of 0.0002 m² and a difference in maximum area of 0.0008 m² between the previous and current reporting periods.
- TS01.02.05. Bank slippage exposed this gametophyte-only colony, which was first recorded in 2016. Since that time, the bank has revegetated, making access to this colony difficult. Originally, each individual patch was measured, but this was not feasible to do when monitoring. At the most recent site visit, an inspection was carried out and an estimated AoO recorded (0.063 m²) with a maximum area visible of 0.62 m². In 2016, the AoO was calculated at 0.32 m² with a maximum area of 1.2 m². As the bank continues to revegetate, this colony will become more difficult to access. A fail was returned for this colony due to loss of area. There was no obvious pressure identified, and it is possible that part of the colony is hidden behind vegetation or soil; however, the surveyors believe that failing the whole population based on this colony is not warranted. The area of this colony should be monitored going forward.
- TS01.03.04. Juveniles were recorded at this colony in the previous reporting period but were not observed in the current reporting period. There was no obvious pressure and this likely represents natural turnover.

Population TS09, Co. Kerry

- TS09.01.01. There was a reduction in AoO of 24% (from 0.13 m² to 0.11 m²) and a reduction in frond numbers of 19% (from 37 to 28 fronds) between reporting periods. This is most likely a result of natural turnover. Based on the overall good appearance of the colony and the diversity of frond types (mature sterile, young expanding, and crozier), a pass was returned for both indicators in relation to this colony.

Population TS23, Co. Donegal

- TS23.01.01. A maximum area of 0.05 m² was input in error for the last reporting period instead of a maximum area of 0.24 m².

Population TS25

- TS25.01.03. The maximum area of this gametophyte-only colony for the previous reporting period of 0.73 m² is believed to be incorrect. The area reported in 2011 was 0.135 m² and it was 0.14 m² in the current reporting period. Therefore, it is likely that an error occurred when measuring the area at that time. However, this will be noted on the updated Individual Assessment Sheet so that it can be checked at future site visits.

****Unfavourable result, overall Conservation Status Assessment Unfavourable**

Population TS10, Co. Kerry

- TS10.01.01. Fronds were flushed out of the crevice, likely due to a strong flow of water during heavy rain, resulting in some being exposed. There was an 84% reduction in AoO and a 51% reduction in frond numbers since the last reporting period. The rhizome was still intact, and it is likely that there are fronds remaining inside the crevice. However, it was difficult to assess this due to weather conditions. This colony will need to be monitored going forward. There was a 17% reduction in maximum area of gametophytes but no obvious pressure. The flooding from the sporophyte crevice above did not appear to impact the gametophytes, which looked healthy.
- TS10.01.02. There was a 25% reduction in maximum area of this gametophyte colony. There is no obvious pressure. This was not considered a fail for this colony, which occurs beneath a boulder with very narrow access making measurements difficult. There was some leaf litter present which may have obstructed part of the colony.

Population TS14, Co. Kerry

- TS14.01.01. A 12% reduction in AoO of sporophytes and a 41% reduction in frond numbers was recorded. Although natural turnover may account for some of the reduction, there appears to be a pressure on frond numbers due to native species that are becoming problematic for this colony (*Hedera hibernica* and *Saxifraga hirsuta*). These species are growing over the fronds and putting weight on the colony, with many dead fronds beneath. Canopy cover from the tree layer was not sufficient (Domin 5), but the *Luzula sylvatica* growing from the bank above the colony is providing sufficient shade to the colony. It is likely that the two encroaching species are responding to the relatively open canopy.

Population TS22, Co. Cork

- TS22.01.02. This small colony, which supports young and juvenile sporophytes, was significantly impacted by bank slippage due most likely to *Prunus laurocerasus* slipping down. There was a reduction in sporophyte AoO of 96% (from 0.02 m² to 0.0007 m²), a 71% reduction in mature frond numbers (from 14 mature and 49 juvenile sporophytes to 4 mature and 8 juveniles), and a 67% reduction in gametophyte maximum area (from 0.16 m² to 0.05 m²).

Population TS25, Co. Cork

- TS25.01.02. There was an apparent reduction in the sporophyte AoO of 50%. This colony is engulfed by *Rubus fruticosus* agg., making it very difficult to measure it effectively. The *R. fruticosus* agg. is providing essential canopy cover at present and the sporophytes that are visible appear healthy. However, there was also a reduction of 53% in estimated frond numbers. Therefore, an Unfavourable–Inadequate Conservation Status was returned for this population. Although some of the difference in AoO and frond numbers may be due to the difficulties of obtaining precise measurements and counts, the magnitude of the difference suggests that a genuine decline has occurred.

Population TS26, Co. Waterford

- TS26.01.19. This colony was inaccessible during the current reporting period. It had an Unfavourable–Inadequate conservation assessment in the last reporting period due to loss of area and frond numbers as a result of *P. laurocerasus* slippage. This invasive alien species is still problematic where this colony occurs and throughout a significant proportion of this site.
- TS26.01.21. This colony had a reduction in sporophyte AoO and frond numbers (20% and 28% respectively) since the last reporting period. It was noted that fronds were withered at the outer edges of the colony. The nature of the pressure was not clear, but an impact was evident. This should be monitored in the future.

3.2.2 Habitat for the species assessment

Habitat for the species assesses the area and quality of the habitat in which the species occurs. For the last two reporting periods, proximity to a water source, humidity/substrate moisture, shade, canopy cover (in woodland locations) and the presence of invasive non-native or vigorous native species within close proximity of the sporophyte generation were recorded. However as recommended in the previous monitoring report (Ní Dhúill *et al.*, 2022), for the indicator ‘Presence of invasive alien species or vigorous native species’ the target is ‘no obvious impact on colony’ (see Sections 1.5.3 and 2.4.3). Current values are compared with baseline target values to assess the Conservation Status of each population. See Section 2.4.3 and 2.4.4 for details of the targets set for the different generations and different habitats.

For the *Habitat for the species* assessment, if any single colony within a population fails for any indicator, then the whole population fails for that indicator.

Table 22 shows results for canopy cover (Domin scale), shade (Shade Index value), and encroachment of non-native invasive species or vigorous native species (Domin scale scores). No population failed on humidity/substrate moisture, therefore the results for this attribute are not included below. The results for the indicators set out in Table 22 show the lowest score for any colony within a population for canopy cover and shade, with the highest score reported for encroachment of non-native invasive species or vigorous native species. This does not mean that all colonies in a population have that score.

Table 22 *Habitat for the species* assessment for 2019–2024 for each population showing results for canopy cover (Domin scale scores), shade (Shade Index values) and encroachment of vigorous native or invasive non-native species (Encroach Domin scale scores) in sporophyte colonies, with overall Conservation Status Assessment for each population. The asterisks * and ** relate to results that appear to be Unfavourable/Favourable respectively and are explained in the section below the table. Gen. = generations; na = not assessed; IAS = invasive alien species; PNS = problematic native species. No impact = No obvious impact on colony.

Pop. Code	County	Gen.	Canopy cover 2013-2018	Canopy cover 2019-2024	Shade index 2013-2018	Shade index 2019-2024	Encroach. at S col. 2013-2018	Encroach. of IAS or PNS at S cols. 2019-2024	Conservation Status
TS01	Tipperary /Limerick	SG	4	*7	2	4	4	No impact	Favourable***
TS05	Kerry	S	na	na	5	5	0	None	Favourable
TS07	Carlow	SGJ	9	9	7	7	4	No impact	Favourable
TS08	Cork	SG	7	**7	3	4	3	No impact	Unfavourable-inadequate
TS09	Kerry	SG	na	0	5	5	0	None	Favourable
TS10	Kerry	SG	na	0	5	5	0	No impact	Favourable
TS11	Kerry	SG	na	0	7	7	0	None	Favourable
TS13	Kerry	SGJ	na	na	na	7	na	None	Favourable
TS14	Kerry	SGJ	5	**5	4	4	4	Impacting colony	Unfavourable-inadequate
TS15	Kerry	SGJ	na	0	5	5	4	None	Favourable
TS16	Limerick	SG	na	0	7	7	4	# No impact	Favourable
TS17	Sligo	SG	na	0	5	5	3	None	Favourable
TS19	Kerry	SG	9	8	4	4	0	None	Favourable
TS20	Limerick	SG	7	0	4	4	5	No impact	Favourable***
TS21	Donegal	SG	8	8	4	4	0	None	Favourable
TS22	Cork	SGJ	9	10	6	6	4	**Impacting 2 colonies	Unfavourable-Inadequate

Pop. Code	County	Gen.	Canopy cover 2013-2018	Canopy cover 2019-2024	Shade index 2013-2018	Shade index 2019-2024	Encroach. at S col. 2013-2018	Encroach. of IAS or PNS at S cols. 2019-2024	Conservation Status
TS23	Donegal	SG	na	0	7	7	na	None	Favourable
TS24	Kerry	SGJ	9	8	6	6	4	No impact	Favourable
TS25	Cork	SG	8	8	3	4	10	**Impacting colony TS25.01.02	Unfavourable-Inadequate
TS26	Waterford	SGJ	9	8	6	6	7	No impact	Favourable
TS30	Cork	SGJ	9	10	4	4	4	No impact	Favourable
TS32	Kerry	S	na	5	na	0	na	None	Favourable
TS36	Kerry	G	na	10	na	7	na	None	Favourable
TS40	Kerry	S	na	0	na	5	na	None	Favourable
TS43	Waterford	SGJ	na	9	na	4	na	None	Favourable
TS44	Cork	SG	na	7	na	0	na	None	Favourable
TS48	Kerry	SG	na	7	na	0	na	None	Favourable
TS49	Kerry	SGJ	na	9	na	4	na	None	Favourable
TS53	Kerry	GJ	na	0	na	7	na	None	Favourable
TS54	Kerry	SG	na	0	na	7	na	None	Favourable
TS56	Wicklow	G	na	10	na	6	na	None	Favourable
TS58	Kerry	G	na	9	na	7	na	None	Favourable
TS59	Kerry	S	na	9	na	6	na	None	Favourable
TS62	Waterford	G	na	9	na	6	na	None	Favourable
TS63	Waterford	G	na	10	na	7	na	None	Favourable
TS64	Kerry	S	na	0	na	7	na	None	Favourable
TS66	Kerry	SG	na	9	na	4	na	None	Favourable
TS67	Cork	SGJ	na	9	na	4	na	No impact	Favourable
TS68	Cork	SGJ	na	10	na	6	na	None	Favourable
TS69	Kerry	SGJ	na	# 5, 10	na	6	na	None	Favourable
TS71	Kerry	GJ	na	9	na	7	na	None	Favourable
TS72	Kerry	SGJ	na	0	na	7	na	None	Favourable
TS73	Kerry	G	na	10	na	7	na	None	Favourable
TS77	Wexford	SGJ	na	9, 19	na	4, 5	na	No impact	Favourable
TS78	Cork	SGJ	na	9, 10	na	4	na	No impact	Favourable
TS79	Kerry	G	na	0	na	5	na	None	Favourable
TS80	Cavan	G	na	9	na	4	na	None	Favourable
TS81	Kerry	SGJ	na	10	na	6	na	None	Favourable
TS85	Kerry	G	na	0	na	7	na	None	Favourable

Below are explanatory notes for the Favourable Conservation Status of one population denoted in Table 22 with a single asterisk, and for the Unfavourable–Inadequate Conservation Status of populations highlighted with a double asterix. Populations where the Conservation Status has changed from Unfavourable to Favourable are explained and highlighted with a triple asterix. Additional notes are highlighted with the # symbol.

*Unfavourable result, overall Conservation Status Assessment Favourable

Population TS01

- TS01.02.01. *Luzula sylvatica*, *Hedera hibernica* and *Rubus fruticosus* agg. growing on the bank above this colony are providing additional canopy cover and are not negatively impacting the sporophytes in this colony at present.

****Unfavourable result, overall Conservation Status Assessment Unfavourable**

Population TS08, Co. Cork

- TS08.01.02 had an Unfavourable–Inadequate *Habitat for the species* conservation assessment in the previous reporting period due to loss of canopy cover. The tree layer was observed to be recovering when monitored during the current reporting period. However, there was evidence of browning of c. 40 fronds on the more exposed left-hand side of colony TS08.01.02, some of which is likely natural turnover, and some likely due to exposure from treefall previously observed. In addition, encroachment by native species is currently providing essential shading, but could become problematic if the canopy does not recover, or if there is additional treefall. Recovery of the canopy would be expected to reduce the vigour of the two encroaching native species. At present encroachment is considered a low impact. An Unfavourable–Inadequate conservation assessment for *Habitat for the species* is returned due to evidence of impact on fronds at colony TS08.01.02 due to treefall (opening up the canopy). This should be monitored in the future.

Population TS14, Co. Kerry

- TS14.02.01. See explanation in previous section on the *Population* assessment.

Population TS22, Co. Cork

- TS22.01.02. The main pressure on this colony, which supports young and juvenile sporophytes and gametophytes, was due to the invasive alien species *P. laurocerasus* slipping down and impacting the majority of this colony. See explanation in previous section on the *Population* assessment.
- TS22.01.04. *R. fruticosus* agg. is engulfing the sporophytes within this colony. Although providing essential canopy cover, it is rooting into the bank where sporophytes are growing.

Population TS25, Co. Cork

- TS25.01.02. *R. fruticosus* agg. is engulfing the sporophytes within this colony and is beginning to encroach on sporophytes in the adjacent colony. This colony failed on the indicator for both encroachment and canopy cover.

***** Previously Unfavourable, now Favourable**

- Two populations that had an Unfavourable Conservation Status in the last reporting period are now considered to have a Favourable Conservation Status due to recovery of canopy cover (TS01, Co. Tipperary) and measures implemented regarding invasive alien species management at TS20, Co. Limerick.

Additional notes

- TS69.01.01, Co. Kerry. This gametophyte-only colony was surveyed for the first time during the current reporting period. The target for canopy cover was not met, however, this gametophyte colony occurs in a crevice and would not be expected to be impacted by loss of canopy cover.
- TS16.01.01, Co. Limerick. *Hedera hibernica* was recorded encroaching on sporophytes close to the opening holding the species. This is not currently a significant impact but should be monitored in future.

3.3 Pressures, threats and other activities

V. speciosa is potentially threatened by a wide variety of activities. These activities can affect the populations directly (e.g. the loss of plants through land clearance for developments, or removal by collection of samples) or indirectly by alteration of habitat conditions (e.g. removal of woodland, alteration of watercourses, etc., leading to a reduction in relative humidity and

subsequent desiccation of plants). The main threats are loss of habitat, invasive alien species (such as *Rhododendron ponticum* and *Prunus laurocerasus*), exposure due to canopy loss, encroachment of vigorous native species (such as *Rubus fruticosus* agg.) and clearance of invasive species.

Nationally, no pressures/threats were identified as being of high or medium importance at the *V. speciosa* national population level. At the individual population level, no high impacting pressures or threats were identified, although the broader habitats within which *V. speciosa* grows are in poor condition at most sites and are subject to a range of threats and pressures. These threats and pressures are not significantly negatively impacting the populations of *V. speciosa* specifically at present, as the species occupies such as limited niche.

Of the 49 populations surveyed, 12 impacting activities were recorded at 33 populations, with six individual populations having Unfavourable-Inadequate Overall Conservation Status due to negative impacting activities (details below and in Table 23). Not all impacting activities are negative and there can be activities that may have a positive or neutral impact on the species.

Pressures were having a medium impact on *V. speciosa* at six populations: TS08, Co. Cork, (PM01 Storm or cyclone); TS10, Co. Kerry (PM02 Flooding); TS14 Co. Kerry (PI03 Problematic native species); TS22, Co. Cork (PI02 Other invasive species; PM05 (Avalanches, landslides, and collapse of terrain); TS25, Co. Cork (PI03 Problematic native species); and TS26, Co. Waterford (PI02 Other invasive species). All other impacts recorded were having a low impact on the species. Details of all impacting activities recorded are in Table 23 below:

Table 23 Impacting activities recorded at *Vandenboschia speciosa* populations (2019–2024) including details of the impact on populations.

Code	Details
PA07 (Intensive grazing or overgrazing by livestock)	Considered a threat to sporophyte populations that are accessible to grazing livestock; however, there was no evidence of any impact from this activity at any of the populations visited during the 2019–2024 reporting period. Grazing does not pose as much of a threat to gametophyte colonies, which are not usually within the reach of grazing livestock. Herbivory by invertebrates of the gametophyte generation, although not a current pressure, may pose a threat to this generation; however, observation of this activity has not been reported to date. If such an impacting activity is observed in the future, it should be recorded and included in the <i>Future prospects</i> assessment. PA07 was recorded as a low impacting activity at TS09, Co. Kerry; TS17, Co. Sligo; and TS30, Co. Cork.
PA09 (Burning for agriculture)	Although the threat of fire (burning down) was highlighted due to an historical burning event (TS16), the impact of this activity is considered low at present.
PB17 (Use of biocides, hormones, and other chemicals (herbicides))	Recorded at one colony at a population in Co. Kerry (TS69.01.01). A bright green chemical residue was observed on <i>R. ponticum</i> seedlings with evidence that the chemical leaked into the crevice where a <i>V. speciosa</i> gametophyte-only colony occurs, however, there was no evidence that the colony has been impacted.
PB26 (Other forestry activities (e.g. pruning))	Considered a low impact at two populations (TS67, Co. Cork, where there was woodland clearance in the vicinity, and TS69, Co. Kerry, where a sporophyte colony (TS69.01.02) was newly discovered during <i>R. ponticum</i> pruning).
PF05 (Sports, tourism, and leisure activities)	Considered a low impact at locations near five populations that are used for leisure and recreational purposes. Three are very close to popular well-used paths (TS19, TS24, TS69, Co. Kerry). TS01, Co. Tipperary is near a docking area for kayakers, and TS68, Co. Cork is located in an easily accessible location at the back of a garden of a private home.

Code	Details
	<i>Rhododendron ponticum</i> was considered to be having a low impact at eight populations where sporophytes occur (TS01, Co. Tipperary and Co. Limerick; TS20, Co. Limerick; TS24, TS49, TS69, TS71, TS81 Co. Kerry; TS25, Co. Cork). <i>Prunus laurocerasus</i> is having a medium impact at two populations (TS22, Co. Cork and TS26, Co. Waterford) by causing bank slippage. <i>P. laurocerasus</i> is considered a low impact at present at TS20, Co. Limerick.
PI02 (Other invasive species)	Three other non-native species were also recorded as having a low impact at seven populations: TS17, Co. Sligo, <i>Acaena ovalifolia</i> was recorded in the vicinity of both colonies in this population - this species is reported as a medium impact species in a report on Ireland's invasive and non-native species (O'Flynn <i>et al.</i> , 2014) and, as such, its spread at TS17, Co. Sligo should be monitored; TS30, Co. Cork, <i>Sasa</i> sp. (Bamboo) which is being managed by the landowner. The alien species <i>Epilobium brunnescens</i> was recorded in the vicinity of colonies at four open upland populations where sporophytes occur (TS09, TS10, TS54, Co. Kerry; and TS44, Co. Cork); and one woodland population (TS78, Co. Cork). The impact, if any, of these three species on <i>V. speciosa</i> or its habitat is unknown.
PI03 (Problematic native species)	Recorded as a medium impact at two populations (TS14, Co. Kerry and TS25, Co. Cork) which both failed on the target for ' <i>no obvious impact on colony</i> ' (see Habitat for the species assessment). Both populations had an Unfavourable–Inadequate Conservation Status. Problematic native species were recorded as having a low impact at an additional three populations (TS08, Co. Cork; TS16, Co Limerick, (where <i>Hedera hibernica</i> is beginning to encroach on the sporophytes), and at TS20, where <i>R. fruticosus</i> agg. is growing vigorously in response to treefall).
PK01 (Mixed source pollution to surface and ground waters)	Considered a low impact at four populations (TS05, TS54, TS59, Co. Kerry; TS80, Co. Waterford). The streams in these locations appeared polluted and had algae on the rocks.
PM01 (Storm or cyclone)	Storms and extreme weather conditions was considered the reason for treefall at three populations which blocked access to some colonies and opened up space in the canopy (TS20, Co. Limerick; TS24, Co. Kerry; TS26, Co. Waterford). It was considered a low impact at these populations, and at TS01, Co. Tipperary/Co. Limerick; TS25 and TS78, Co. Cork. It was considered a medium impact at TS08, Co. Cork, where there was evidence of impact on one colony due to treefall that occurred in the previous reporting period (see Habitat for the species assessment for details). With the increase in extreme weather events, this may become a major impact for many populations in the future if essential canopy cover is lost or if falling trees directly damage colonies. It is likely that climate change is increasing the frequency of treefall at woodland sites where the species occurs (a highly likely future impact is PJ07 Cyclones, storms, or tornados due to climate change at these locations).
PM02 (Flooding)	Frequently recorded as having a low impact, with the exception on one colony with sporophytes where flooding was considered to have had a medium impact on a single colony which was observed to be partly dislodged (TS10, Co. Kerry) (see <i>Population and Habitat for the species</i> assessments for details). Flooding was recorded as a low impact at nine other populations (TS23, Co. Donegal; TS43, Co. Cork; TS11, TS40, TS54, TS56, TS59, TS64, Co. Kerry; TS77, Co. Wexford).
PM05 (Avalanches, landslides and collapse of terrain)	Observed at five populations. Considered a medium impact for one population (TS22, Co Cork) and a low impact at four populations (TS08, Co. Cork; TS14, TS24, Co. Kerry; TS26, Co. Waterford).

Although the threat of deliberate collection of the species is much reduced from levels seen during the “Victorian Fern Craze” (see Allen (1969) and Whittingham (2009)) there remains a

low-level threat to some colonies from this activity. For this reason, the precise locations of colonies of the species are not made generally available.

Climate change is likely to affect the species and the habitat for the species in Ireland in decades to come if average temperatures continue to rise and with the occurrence of more frequent extreme weather events. As mentioned, it is likely that climate change is increasing the frequency of treefall at woodland sites where the species occurs. While the trigger for the development of juvenile sporophytes from gametophytes is unclear, it may, at least in part, be due to climatic factors, e.g. warmer temperatures, which would be considered a positive impact. On the other hand, however, the extremes in predicted weather from warm, wet winters to periodic droughts in summer will likely negatively impact *V. speciosa* colonies, particularly the sporophyte generation, which is especially sensitive to desiccation.

Table 24 shows the number of populations affected by a pressure, threat or impacting activity. For each pressure, the timing is recorded (this is the time frame it is acting in) and each is listed as *in the past but now suspended due to measures*; *ongoing*; *ongoing and likely to be in the future*; or *only in the future*. Scope is also recorded, i.e. proportion of the population affected) and is listed as *whole (>90%)*; *majority (50-90%)*; or *minority (<50%)*. Influence on the *Population* or *Habitat for the species* is recorded as high, medium or low influence. Table 24 below lists impacts at the site level. There were no high impacting pressures/threats identified at any of the individual populations monitored. Any low to medium impacting pressures recorded during surveys were generally considered a local issue.

Table 24 List of impacting activities recorded at 33 *Vandenboschia speciosa* populations (2019–2024), indicating the number of populations, the timing (timeframe it acted in), scope (proportion of the population affected), influence on the *Population* or *Habitat for the species*, and estimated impact.

Code	Pressure/ Threat	No. of pops	Timing	Scope	Influence	Estimated impact
PA07 (Intensive grazing or overgrazing by livestock)	Threat	3	Only in the future	minority <50%	Low	Low
PA09 Burning for agriculture	Threat	1	Only in the future	minority <50%	Low	Low
PB17 (Use of biocides, hormones, and other chemicals (herbicides))	Threat	1	Only in the future	minority <50%	Low	Low
PB26 (Other forestry activities (e.g. pruning))	Threat	2	Only in the future	minority <50%	Low	Low
PF05 (Sports, tourism, and leisure activities)	Threat	5	Only in the future	minority <50%	Low	Low
PI02 (Other invasive species)	Pressure	17	Ongoing and likely to be in the future	minority <50%	Medium (two pops)	Medium (two pops)
PI03 (Problematic native species)	Pressure	5	Ongoing and likely to be in the future	minority <50%	Medium (two pops.)	Medium (two pops.)
PJ07 (Cyclones, storms, or tornados due to climate change)	Pressure	7	Ongoing and likely to be in the future	minority <50%	Low	Low
PK01 (Mixed source pollution to surface and ground waters)	Threat	4	Only in the future	minority <50%	Low	Low
PM01 (Storm or cyclone)	Pressure	7	Ongoing and likely to be in the future	minority <50%	Medium (one pop.)	Medium (one pop.)
PM02 (Flooding)	Pressure	10	Ongoing and likely to be in the future	minority <50%	Medium (one pop.)	Medium (one pop.)
PM05 (Avalanches, landslides and collapse of terrain)	Pressure	5	Ongoing and likely to be in the future	minority <50%	Medium (one pop.)	Medium (two pops.)

3.4 Future prospects assessment

3.4.1 Site level assessment of Future prospects

The *Future prospects* assessments of the 49 *V. speciosa* populations surveyed during the 2019–2024 reporting period, and notes on the rationale for each, are in Appendix 4.

The effects of the impacting activities, timing, scope and influence 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).

In the previous reporting period, seven populations had an overall Unfavourable–Inadequate Conservation Status, compared with six in the current reporting period. A comparison between six populations that were assessed in 2013–2018 and 2019–2024 reporting periods (TS01; TS08; TS20; TS22; TS25; TS26) is set out below:

- Two populations that had an overall Unfavourable–Inadequate Conservation Status in the last reporting period are now considered to have a Favourable Conservation Status (2019–2024) and passed all targets due to recovery of canopy cover (TS01, Co. Tipperary) and measures implemented regarding invasive species management at TS20, Co. Limerick.
- Two sporophyte colonies in two separate multi-colony populations were declared extinct in the last reporting period, with both populations having an Unfavourable–Inadequate Conservation Status (TS20, Co. Limerick; and TS22, Co. Cork). The issues that brought about their demise (removal of *Rhododendron ponticum* canopy at TS20.04.01 and trampling at TS22.01.08) have been addressed. The remaining colonies within both populations were not impacted by the pressures that resulted in the loss of those colonies. TS20 is now considered to have a Favourable Conservation Status, whilst TS22 remains Unfavourable–Inadequate due to ongoing issues with invasive alien species.
- Four populations retained an Unfavourable–Inadequate Conservation Status between the previous and current reporting periods (TS08, TS22, TS25, Co. Cork; and TS26, Co. Waterford).

Pressures acting on the six populations assessed during the current reporting period with an Unfavourable–Inadequate Conservation Status are detailed in Sections 3.2 and 3.3. A brief summary of the five pressures negatively impacting colonies with sporophytes is given here:

- Invasive alien species (PI02), in particular *Prunus laurocerasus*, are causing bank slippage at TS22, Co. Cork and TS26, Co. Waterford and impacting a number of colonies with sporophytes. Both are large multi-colony populations.
- Problematic native species (PI03): *Rubus fruticosus* agg. is impacting sporophytes at a colony at TS25, Co. Cork. *Hedera hibernica* and *Saxifraga hirsuta* are impacting sporophytes at TS14, Co. Kerry.
- Flooding (PM02) impacted a population with a single colony with sporophytes at TS10, Co. Kerry.
- Avalanches, landslides and collapse of terrain (PM05) was impacting sporophytes and gametophytes at one colony within a large population (TS22, Co. Cork).
- Storm or cyclone (PM01) along with extreme weather conditions was considered to have caused treefall at a population in Co. Cork (TS08) which impacted sporophytes at one colony.

Table 25 gives a summary of the number of populations with an Unfavourable–Inadequate Conservation Status for the current reporting period (2019–2024).

Table 25 Summary of the six *Vandenboschia speciosa* populations with Unfavourable–Inadequate (U–I) Conservation Status assessments for *Population*, *Habitat for the species*, and *Future prospects*, for the reporting period 2019–2024.

Conservation Status Assessment (2019–2024)	Number of populations U–I	Population codes
U–I Population Assessment	5	TS10, TS14, Co. Kerry; TS22, TS25, Co. Cork; TS26, Waterford
U–I Habitat for the species Assessment	3	TS08, TS25, Co. Cork; TS14, Co. Kerry
U–I Future prospects Assessment	6	TS08, TS22, TS25, Co. Cork; TS10, TS14, Co. Kerry; TS26, Waterford
U–I Overall Conservation Status	6	TS08, TS22, TS25, Co. Cork; TS10, TS14, Co. Kerry; TS26, Waterford

The presence of invasive alien species in particular is a difficult impacting activity to quantify or to manage where populations of *V. speciosa* occur. The presence of such species provides shelter and canopy cover, and helps maintain sufficient relative humidity at locations where *V. speciosa* colonies occur, although it negatively impacts the broader habitat.

For the previous reporting period, Ní Dhúill *et al.* (2022) noted that the removal of invasive alien species in the immediate vicinity of *V. speciosa* colonies was not advised, as such a drastic measure may pose a greater threat to the *V. speciosa* colonies than would leaving the invasive species *in situ*. However, it was noted that the control of their spread in locations where *V. speciosa* colonies occur was a conservation measure that would be expected to have a positive outcome for the future of these habitats. It was stated that any control plan implemented must be undertaken sensitively and with the requirements of *V. speciosa* in mind. The possible future effects of this threat are based on expert opinion and from surveys carried out where these invasive species occur.

During the current reporting period, Conservation Measures implementation was piloted for two multi-colony populations to address invasive alien species (PI02), in particular *P. laurocerasus*, and problematic native species (PI03), in particular *R. fruticosus* agg. Details are outlined in Section 4 (Conservation Measures).

3.4.2 National conservation assessment of *Future prospects*

Following EU guidance (DG Environment, 2023), the following national assessment was made for the *Population* and *Habitat for the species* of *V. speciosa* (species code 6985). Short-term is defined as over the last 12 years.

Range

- Short-term trend direction of *Range* is assessed as stable
- Current range is equal to Favourable Reference Range
- Conservation Status of *Range* is therefore Favourable
- Future trend of *Range* is assessed as stable
- *Future prospects* of *Range* are therefore good

Population

- Short-term trend direction of *Population* is assessed as stable
- The current number of colonies (501) and maximum area (962 m²) approximately equate to a Favourable population size
- Future trend of *Population* is assessed as stable
- *Future prospects* for *Population* are therefore good

Habitat for the species

- Short-term trend direction of *Habitat for the species* is stable
- Future trend of *Habitat for the species* is assessed as stable
- *Future prospects* of *Habitat for the species* are therefore good

3.5 Overall conservation assessment

3.5.1 Overall conservation assessments at site level (surveyed)

The assessments of the individual parameters at each site were combined according to guidance provided by the EU (DG Environment, 2022, 2023) and criteria developed specifically for *V. speciosa* (Table 13) to obtain the overall conservation assessment for each of the 49 monitored *V. speciosa* populations. This resulted in 43 populations receiving a Favourable assessment across the three parameters and six an Unfavourable–Inadequate assessment (Table 26). Although six populations had an overall Unfavourable–Inadequate assessment, the factors giving rise to these are considered to be local issues and are not currently regarded as a threat at the national level. Table 26 shows the results of the overall conservation assessment when all three parameters were assessed for the *V. speciosa* population surveyed.

Table 26 Results of the overall conservation assessment when all three parameters were assessed for the 49 *Vandenboschia speciosa* populations monitored in the 2019–2024 reporting period. Gen. = generations. F = Favourable; U–I = Unfavourable–Inadequate. None were assessed as Unfavourable–Bad.

Pop. Code	County	Gen.	Population	Habitat for the species	Future prospects	Overall Conservation Status
TS01	Tipperary/ Limerick	SG	F	F	F	F
TS05	Kerry	S	F	F	F	F
TS07	Carlow	SGJ	F	F	F	F
TS08	Cork	SG	F	U–I	U–I	U–I
TS09	Kerry	SG	F	F	F	F
TS10	Kerry	SG	U–I	F	U–I	U–I
TS11	Kerry	SG	F	F	F	F
TS13	Kerry	SGJ	F	F	F	F
TS14	Kerry	SGJ	U–I	U–I	U–I	U–I
TS15	Kerry	SGJ	F	F	F	F
TS16	Limerick	SG	F	F	F	F
TS17	Sligo	SG	F	F	F	F
TS19	Kerry	SG	F	F	F	F
TS20	Limerick	SG	F	F	F	F
TS21	Donegal	SG	F	F	F	F
TS22	Cork	SGJ	U–I	F	U–I	U–I
TS23	Donegal	SG	F	F	F	F
TS24	Kerry	SGJ	F	F	F	F
TS25	Cork	SG	U–I	U–I	U–I	U–I

Pop. Code	County	Gen.	Population	Habitat for the species	Future prospects	Overall Conservation Status
TS26	Waterford	SGJ	U-I	F	U-I	U-I
TS30	Cork	SGJ	F	F	F	F
TS32	Kerry	S	F	F	F	F
TS36	Kerry	G	F	F	F	F
TS40	Kerry	S	F	F	F	F
TS43	Waterford	SGJ	F	F	F	F
TS44	Cork	SG	F	F	F	F
TS48	Kerry	SG	F	F	F	F
TS49	Kerry	SGJ	F	F	F	F
TS53	Kerry	GJ	F	F	F	F
TS54	Kerry	SG	F	F	F	F
TS56	Wicklow	G	F	F	F	F
TS58	Kerry	G	F	F	F	F
TS59	Kerry	S	F	F	F	F
TS62	Waterford	G	F	F	F	F
TS63	Waterford	G	F	F	F	F
TS64	Kerry	S	F	F	F	F
TS66	Kerry	SG	F	F	F	F
TS67	Cork	SGJ	F	F	F	F
TS68	Cork	SGJ	F	F	F	F
TS69	Kerry	SGJ	F	F	F	F
TS71	Kerry	GJ	F	F	F	F
TS72	Kerry	SGJ	F	F	F	F
TS73	Kerry	G	F	F	F	F
TS77	Wexford	SGJ	F	F	F	F
TS78	Cork	SGJ	F	F	F	F
TS79	Kerry	G	F	F	F	F
TS80	Cavan	G	F	F	F	F
TS81	Kerry	SGJ	F	F	F	F
TS85	Kerry	G	F	F	F	F

3.5.2 Overall National Conservation Status Assessment

The assessments of the individual parameters were combined according to guidance provided by the EU (DG Environment, 2022, 2023) and criteria developed specifically for *V. speciosa* (Table 13).

Following the guidelines for *Population* assessment at a national level (DG Environment, 2022, 2023), based on the results presented here and taking into account localised issues at six populations and conservation measures in place for the species, the overall National Conservation Status Assessment result for *V. speciosa* populations is Favourable and the trend is stable. The data detailed in the preceding sections of this report were used to arrive at this result.

There has been an expansion of the range of *V. speciosa* since the last reporting period on foot of the new gametophyte record for Co. Louth (TS123), although, it is likely that this

population has been there for some time, as the gametophyte is extremely slow growing. Regarding Co. Clare, as the species was historically known from that county, but was considered extinct, the recent records from 2021–2024 reflect an expansion in that location, although not an expansion in the range.

Favourable Reference Range is set as approximately equal to the current range (13,500 km²). Since the last reporting period, the range of this species has increased from 10,100 km² (a 34% increase). Short-term trend in *Range* was deemed to be stable. The increase in population and colony numbers is due to improved knowledge and more accurate data rather than expansion of newly established populations. *Range* is assessed as Favourable as there is no evidence of a decline since the EU Habitats Directive came into force.

There are currently 78 x 10 km grid squares (7,800 km²) that have at least one *V. speciosa* record. This represents a 39% increase (from 5,600 km², see clarification note in Section 3.1.1, above) since the last reporting period (2013–2018).

The main factor that may change this assessment in future monitoring periods is the presence of invasive non-native species. This is a difficult impacting activity to quantify or to manage for populations where *V. speciosa* occurs as, although they are undoubtedly a significant negative impact on the general habitat, they are presently having a positive impact on the sporophyte colonies due to the shade and canopy cover that they provide. Impacts from invasive alien species are considered likely to impact the quality of the habitat in the future and, unless a strategy is devised to eliminate/control these non-native species in the long term without significantly impacting *V. speciosa* colonies, the Conservation Status will not remain Favourable in the future. Impacts from climate change, in the form of treefall resulting from more frequent and intense storm events, may also indicate a change in Conservation Status to Unfavourable in future reporting periods.

Table 27 summarises the result of the National Conservation Status Assessment for the Irish populations of *V. speciosa*.

Table 27 Summary of the National Conservation Status Assessment of *Vandenboschia speciosa* populations, based on the results of the 2019–2024 survey.

Parameter	Conservation Status	Trend	Future prospects
Range	Favourable	Stable	Good
Population	Favourable	Stable	Good
Habitat for the species	Favourable	Stable	Good
Overall National Conservation Status Assessment	Favourable	Stable	

3.6 *Vandenboschia speciosa* populations inside and outside the SAC network

V. speciosa is listed on Annex II and IV of the EU Habitats Directive. For species listed in Annex II of this Directive, member states are required to designate Special Areas of Conservation (SACs).

Populations of *V. speciosa* that are listed as QIs of SACs are protected under the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) which regulates any plans or projects that may negatively impact on the species. Protection is afforded to qualifying features of SACs and consent is required to undertake certain activities that may negatively impact them. Damaging activities that may impact the Conservation Status of *V. speciosa* populations are regulated under the European Communities (Environmental Liability) Regulations 2008 (S.I. No. 547 of 2008). In addition, protection is afforded by the Flora (Protection) Order, 2022 (S.I. No. 235 of 2022).

V. speciosa is listed as a QI in 18 of the 34 SACs in which it occurs. A total of 82 of the 136 known populations and 348 of the 501 known colonies of *V. speciosa* are in SACs (60% and 69% respectively) and it is a QI in 65 of these 82 populations (79%).

The 54 populations that are not in an SAC are comprised of:

- 44 populations with gametophytes-only occurring
- Two populations with sporophyte and gametophyte co-occurring (TS121 and TS125, Co. Clare, the latter considered to be the historic 1879, Corry site)
- Seven populations with mature and juvenile sporophytes and gametophytes co-occurring (TS13, TS52 and TS81, Co. Kerry; and TS30, TS67, TS68 and TS78, Co. Cork)
- One population with sporophyte-only (TS70)

Table 28 shows two populations in which not all of their constituent colonies fall within an SAC (TS28, Co. Kilkenny, SAC 2162 and TS65, Co. Mayo, SAC 2243).

Eleven populations, TS86, Co. Cork; TS134, Co. Donegal; TS52, TS70, Co. Kerry; TS37, TS65, TS82, Co. Mayo; TS57, Co. Tipperary; TS80, Co. Waterford; TS03, TS04, Co. Wicklow, are included within a proposed Natural Heritage Area (pNHA) and one, TS93, Co. Cork, is in a Natural Heritage Area (NHA).

With regard to the 49 *V. speciosa* populations monitored during the ‘Baseline and monitoring surveys of selected populations of *V. speciosa* in Ireland, 2021–2024’ project, 39 are within SACs and 36 of these are within SACs that list *V. speciosa* as a QI. Of the three populations where *V. speciosa* is not listed as a QI, two support juveniles and maturing-juveniles (TS49, Co. Kerry and TS77, Co. Wexford), with TS79 supporting gametophyte-only colonies.

Table 28 *Vandenboschia speciosa* populations that have colonies within and outside of an SAC. Gen. = Generation; Cols. = Colonies; SAC = Special Area of Conservation.

Pop. Code	County	Gen. at pop.	SAC code	No. cols. inside SAC	QI	No. cols. outside SAC	Colony codes outside SAC	Gen. at colony
TS28	Kilkenny	G	2162	2	Yes	5	TS28.02.01	G
							TS28.02.02	
							TS28.02.03	
							TS28.02.04	
							TS28.02.05	
TS65	Mayo	G	2243	1	No	2	TS65.01.01	G
							TS65.01.02	

4 Conservation measures

Conservation measures are defined in Article 1 of the EU Habitats Directive as: ‘a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status’ (DG Environment, 2023).

Conservation measures were reported using the updated codified list of measures provided via the Article 17 Portal (2019–2024). Conservation measures are implemented in order to mitigate the impact of past or present pressures (DG Environment, 2023).

The conservation measures identified as required for populations of *V. speciosa* were:

- MI03 Management, control or eradication of other invasive alien species

- MI05 Management of problematic native species
- MI04 Restoration of habitats affected by invasive alien species
- MM02 Minimise/prevent impacts of geological and natural catastrophes

The short-term purpose of the conservation measures is to maintain the current range, population and/or habitat for the species, with the long-term goal being gradual restoration of the native habitat for populations impacted by invasive alien species. For populations impacted by vigorous/problematic native species, the short-, medium-, and long-term aim is to restore canopy cover to sufficient levels to reduce the vigour of the problematic native species.

In the previous reporting period, two populations were identified for conservation measures implementation. The pressures reported at that time are still acting on colonies identified within the two populations (TS22 and TS25, Co. Cork).

Conservation Measures Action Plans were developed to address the issues of invasive alien species and problematic native species at TS22 and TS25, Co. Cork (Ní Dhúill & Hodd, 2023a, b). The aim was to use these two populations as pilot studies for managing invasive alien species and problematic native species that currently provide essential canopy cover to *V. speciosa* colonies within populations. Full details are available in the action plans (Ní Dhúill & Hodd, 2023a, b). Baseline data are available for both populations for the last two reporting periods which will be used to measure any changes (positive or negative) due to conservation measures implementation.

At population TS22, Co. Cork, due to the infestation of *Prunus laurocerasus*, gradual transformation from non-native to native canopy will need to be carried out over the short-, medium- and long-term, with careful management of stands within the habitat where *V. speciosa* occurs and management of *Prunus laurocerasus* and *Rhododendron ponticum* outside the exclusion zones (Ní Dhúill & Hodd, 2023b).

At population TS25, the primary concern is encroachment of problematic native species (*R. fruticosus* agg.), which is a result of the opening up of the canopy through treefall caused by extreme storm events. A gradual transformation of the woodland will be carried out over the short-, medium- and long-term with the aim of encouraging the development of native tree and shrub canopy. A minimum canopy cover of 70% is considered sufficient to prevent *R. fruticosus* agg. from becoming dominant (Cross & Collins, 2017). Full details are available in the action plan (Ní Dhúill & Hodd, 2023a).

Short-term measures were implemented in the winter and late summer of 2024. This included removal of young stands of *R. ponticum* and young *P. laurocerasus* at TS22, before they became problematic. For mature *P. laurocerasus* stands providing essential canopy cover to *V. speciosa* colonies, selective pruning and removal was carried out by NPWS staff under the supervision of ecologists at TS22. For population TS25, short-term measures implemented included clearing an access track to the population and identifying the areas for targeted control of *R. fruticosus* agg. and *R. ponticum*.

Restoration of habitats affected by invasive alien species and problematic native species are part of the medium- and long-term measures for these populations.

5 Discussion

5.1 Conservation Assessment of *Vandenboschia speciosa*

5.1.1 Overall National Conservation Status of *Vandenboschia speciosa*

Based on the results of this survey, the overall National Conservation Status of *V. speciosa* is assessed as Favourable. No colonies were lost during the current reporting period, and although one colony was severely impacted (TS22.01.02) due to the invasive alien species *P. laurocerasus*, the remaining colonies within these multiple-colony populations are not under a current pressure from this species. However, it is considered a threat to four colonies on the river bank (TS22.01.03, 05, 06 and 08). Pressures leading to the negative impact on colony TS22.01.02 were considered a local issue, and not a threat on a national level. As there was no evidence of decline in colony numbers since the EU Habitats Directive came into force, other than those previously reported on, the Conservation Status remains Favourable.

There has been no change in the overall Conservation Status or Conservation Trend since the last reporting period. There has been an increase in population size and in range size, but these are due to improved knowledge and targeted surveys, revealing a fuller picture of the population size and distribution of the species, rather than actual increases in these.

5.1.2 Population

The current known extant population of *V. speciosa* in the Republic of Ireland numbers 136 populations comprising 501 colonies, an increase from 86 populations comprising 290 colonies recorded in the last reporting period. The additional 50 populations represent an increase of 58% in the national number of population records for *V. speciosa*. This is considered a result of targeted surveying, improved knowledge and more accurate data.

Thirty-six of the additional 50 populations occur within 22 new 10 km x 10 km Irish National Grid squares comprising 57 colonies. The majority of these 36 populations are gametophyte-only (28), four are sporophyte-only, three are sporophyte and gametophyte co-occurring, and one has juveniles emerging from gametophytes.

A first record for gametophytes in Co. Louth (TS123) has expanded the range of this generation in Ireland (Flynn, 2024). New populations were also recorded in Co. Clare following intensive recording in 2020–2024 (Ó Catháin, 2023a, b, 2024a, b; Roden *et al.*, 2021), however, as the species was historically known from that county, but was considered extinct, the recent records from 2021–2024 reflect an expansion in that location, although not an expansion in the range. The majority of these new populations were gametophyte-only. The rediscovery of an historic record for a *V. speciosa* sporophyte population (TS125.01.01) in Co. Clare (Ó Catháin, 2023a) that had not been recorded since 1879 was welcome and reinforces the likelihood of the continued existence of historic populations that have not been recorded in recent times, subject to the habitat remaining favourable. The gametophyte generation has been observed more frequently in recent times as botanists and ecologists are becoming more aware of this cryptic generation and its identification.

Of the 49 populations surveyed, the majority supported sporophytes (76%) (this excludes two populations with juveniles emerging from gametophytes). This reflects the selection of populations for 'Baseline and monitoring surveys of selected populations of *Vandenboschia speciosa* in Ireland, 2021–2024' project.

The recording of maturing-juvenile sporophytes in Co. Wexford has expanded the range of the sporophyte generation, as this population was previously recorded as gametophyte-only. The increase in observation of juvenile sporophytes since the last reporting period is considered to be, in part, the result of targeted surveying. The trigger for the development of these juvenile sporophytes from gametophytes is unclear but it may be, at least in part, due to climatic factors

enabling the life cycle to complete itself, perhaps in part due to milder winters. In addition, the recording of maturing-juvenile sporophytes at 50 colonies within 14 populations, increases support for the likelihood of the influence of climatic factors. However, it is still unclear how many of these juveniles and maturing-juveniles will survive.

Fertility of colonies remained unchanged since the previous reporting period, with 37% of populations supporting at least one fertile colony. This was less than the 57% of fertile populations recorded in the 2007–2012 reporting period. However, reduced fertility levels are not considered problematic and are thought to most likely reflect natural fertile frond turnover. Populations that supported fertile sporophytes, juvenile sporophytes emerging from gametophytes, and maturing-juvenile sporophytes were considered to be good indicators of colony health as these provided an indication that historic or recent sexual reproduction may have occurred.

A comparison of the 20 populations that were monitored in the previous and current reporting period showed an increase in newly recorded colonies at these locations. The majority of these 31 newly recorded colonies supported co-occurring mature sporophytes, gametophytes and juvenile sporophytes (SGJ) (20 new colonies (65%)). The majority occurred within woodland habitats, and their observation was mostly due to natural dynamics in these woodland habitats revealing previously unobserved colonies. This is also likely influenced, in part, by climatic factors.

The increase in the area of occupancy of *V. speciosa* since the last reporting period reflects the new colonies recorded and any increases in area of either generation since the last reporting period.

5.1.3 *Habitat for the species*

Impacts from invasive alien species at certain locations are considered likely to impact the quality of the habitat in the future. Although the *Habitat for the species* was assessed as Favourable on a national level, there are concerns about the impact from invasive alien species (*Prunus laurocerasus* and *Rhododendron ponticum*) on the habitats where *V. speciosa* occurs.

The impact of the presence of invasive alien species, in particular *P. laurocerasus* and *R. ponticum* at a number of populations should be assessed in future surveys and, although not considered a national threat at present, the impact could become of medium importance at the habitats where they occur. In two populations in particular, the invasion of *P. laurocerasus* is severe (TS22, Co. Cork and TS26, Co. Kerry) and has impacted sporophyte colonies by slipping down steep banks. The impact of *P. laurocerasus* and *R. ponticum*, and storms causing treefall has been observed at a number of sites during the current reporting period. Although the outlook for the next 12 years is assessed as 'Good', the overall habitat matrix within which *V. speciosa* occurs is in poor to very poor ecological condition at all but a handful of sites, and the only reason that the *V. speciosa* populations are assessed as being in good condition is that the species occupies a specific, narrow niche that is insulated from impacts on the broader surrounding habitat. However, in the medium- to long-term, *V. speciosa* is likely to be significantly impacted by the negative impacts acting on the surrounding habitats and it is likely that human intervention will be needed more often to maintain the *Population* and *Habitat for the species* in good condition in the future.

The habitat of *V. speciosa* is currently largely in good condition, and most suitable areas identified at known populations still support *V. speciosa*. While *Habitat for the species* was assessed as Favourable, as noted above, this habitat assessment only assesses the narrow habitat niche of *V. speciosa* and is not an indication of the overall condition of the broader habitat in which *V. speciosa* occurs, indicating only that the habitat is suitable for *V. speciosa*. It is likely that, as there is a greater focus on habitat restoration in the future, a conflict will arise in some locations between the conservation in good condition of populations of *V. speciosa* and the broader habitat within which they occur. Such a situation will require sensitive and careful planning and consideration.

5.1.4 Impacts/Activities and *Future prospects*

Of the 49 *V. speciosa* populations monitored during the current reporting period, 39 are within an SAC, and 36 are in SACs that list *V. speciosa* as a QI.

In addition, the Flora (Protection) Order, 2022 legally protects all populations. At present, there is no reason to believe that any significant threats will present themselves in the next two reporting periods. However, there is concern for the impact to habitats due to two invasive alien species (*P. laurocerasus* and *R. ponticum*) and due to an increase in extreme storm events.

There were no high impacting pressures or threats identified at any of the 49 individual populations monitored during the current reporting period. As detailed in Section 3.3, impacting activities were recorded at 33 populations out of the 49 visited, with 12 impacting activities recorded at these locations. Of these 33 populations, impacts were having a medium intensity impact at six populations, with the remaining impacts considered to be low intensity (see Tables 23 and 24 for details). At two of these populations (TS22, Co. Cork and TS26, Co. Waterford) the invasive alien species *P. laurocerasus* was considered to be having a negative impact on one colony in each. Although it is recognised that, depending on the context, the same activity may have either neutral, positive or negative impact – *R. ponticum* and *P. laurocerasus* currently provide essential canopy cover and shade to *V. speciosa* sporophyte colonies – their presence in these locations could negatively impact the habitat in the future.

Considering the impacts, pressures and threats to *V. speciosa* in Ireland today, and the implementation of conservation measures at two pilot sites, this species currently appears to have good prospects for the future. This is despite the surrounding habitat of most populations being in poor condition. The overall Conservation Status for *V. speciosa* is Favourable and the overall Conservation Trend is stable.

5.2 Challenges during survey

A few challenges presented themselves over the course of the survey for the current reporting period and subsequent assessments.

1. Monitoring gametophytes

Following recommendations from the previous reporting period, it was considered that comparing maximum area over reporting periods was a more reliable indicator of change. This in general held true. However, in a small number of cases where there was a significant reduction in maximum area, there was no obvious pressure. In one particular instance (TS01.02.05), the revegetation of the slope, following a landslide recorded in the previous reporting period, made access to the colony difficult and it was hard to see the extent of the colony. In that case, although this gametophyte-only colony failed on the target of maximum area, it did not warrant a fail for the whole population. Going forward it is recommended that expert judgement be used in instances where there is an apparent reduction in maximum area of gametophyte before failing the whole population.

2. Conservation measures for populations/colonies impacted by flooding

Flooding was having a significant negative impact on one population (TS10, Co. Kerry). However, determining a suitable conservation measure for this population is difficult due to its location on a sheer cliff face and limitations in terms of protecting the population from the impact of flooding. This will continue to be monitored, and due consideration will continue to be given to potential conservation measures that could be implemented.

3. Difficulty accessing colonies due to treefall

Treefall at three populations blocked access to some colonies (TS20, Co. Limerick; TS24, Co. Kerry; TS26, Co. Waterford). With the increased frequency of extreme weather events, it is likely that there will be more treefall at woodland sites where *V. speciosa* occurs.

6 Recommendations

6.1 Management of invasive alien species and vigorous native species

The presence of invasive alien species is a difficult impacting activity to quantify or to manage for, where populations of *V. speciosa* occur. As outlined in Section 3.4.1, such invasive species may have a positive impact, as they can provide important shelter and canopy cover where native canopy cover has been lost.

It was recommended in the previous reporting period that removal of invasive alien species in the immediate vicinity of *V. speciosa* colonies was not advised, as such a drastic measure may pose a greater threat to the *V. speciosa* colonies than would leaving the invasive species *in situ*. However, considering the negative impact that the invasive alien species *P. laurocerasus* is having at two populations (TS22, Co. Cork and TS26, Co. Waterford), action is required to manage the spread of this species in locations where *V. speciosa* occurs.

It is recommended that the conservation measures currently being implemented at two pilot study sites to control invasive alien species and problematic native species be monitored to determine if these measures are having a positive or neutral impact, and if they may be of benefit at other *V. speciosa* populations where invasive alien species and vigorous native species have been identified as negatively impacting the habitat. Conservation measures success will be evident over the long-term (over the next 50–100 years). It is important that steps are taken now to restore the habitats where *V. speciosa* occurs, as although *P. laurocerasus* and *R. ponticum* provide essential canopy cover and shading at present, their continued presence at these locations is significantly impacting the broader habitat and will likely negatively impact *V. speciosa* colonies over time due to impacts such as bank slippage and excessive shading. Therefore, a wider view in terms of temporal and spatial scale should be taken to determine conservation requirements and priorities.

6.2 Monitoring juvenile sporophytes and maturing-juveniles

The increase in records for sporophytes emerging from gametophytes and maturing-juveniles should continue to be monitored. Little is known of the survival rate of these juvenile sporophytes and maturing-juvenile sporophytes. Continued monitoring will provide valuable information on their survival rates, and it will also provide an opportunity to better understand the trigger for their emergence, which is considered likely due to climatic factors.

During the previous reporting period, for colonies with large numbers of juveniles, their number was estimated using a 25 cm x 25 cm quadrat divided into 5 cm x 5 cm squares for counting juvenile frond numbers for extrapolation. For the current reporting period, it was considered that a visual estimate of juvenile frond numbers was sufficient, as the previous method was considered an inefficient use of time as not all juveniles are expected to survive. Juvenile frond numbers are reported separately from the overall living number of fronds for mature colonies.

6.3 Refinement of *Habitat for the species methodology*

In the previous methodology (Ní Dhúill *et al.*, 2022), 2 m x 2 m relevés were recorded when surveying each population. However, for colonies whose habitat was smaller than the 2 m x 2 m relevé, it was found that this included a large proportion of habitat that had no suitability for *V. speciosa* and was very different in species composition from the area immediately around the colony. Therefore, in the current survey, such relevés were carried out based on the area of the habitat where the colonies occurred, up to a maximum area of 2 m x 2 m.

It was recommended in the previous report (Ní Dhúill *et al.*, 2022) that the area of occupancy (m²) and maximum area (m²) for each generation be reported separately in the individual site

assessments, instead of the total combined areas as was previously reported. This was in order to make comparisons between generations and between years clearer and to make it easier to highlight changes that may be affecting one generation and not the other. It is recommended that this amendment be included in the summary table of each Individual Site Assessment Sheet, with the current and previous areas of occupancy for both generations and maximum areas for the gametophyte generation included separately.

6.4 Inclusion of new sporophyte populations in SACs as a QI

There are three *V. speciosa* populations located within SACs that do not list *V. speciosa* as a QI. Two of these have juvenile sporophytes and maturing-juvenile sporophytes (TS49, Co. Kerry within SAC 000343 (Castlemaine Harbour SAC) and TS77 Co. Wexford, SAC 000781 (Slaney River Valley SAC)). It is recommended that the list of QIs for those sites be updated to include *V. speciosa*. However, it is not recommended that *V. speciosa* be added as a QI for SACs that only support gametophyte or gametophyte and juvenile sporophyte fronds.

6.5 Recommendations of additional SACs for *Vandenboschia speciosa*

It is recommended that all mature sporophyte colonies not currently located within the SAC network are brought into SACs, either through the designation of new SACs or, where located close to the boundary of an SAC, through the expansion of existing SACs. Currently 11 populations that support mature sporophytes are located outside of the SAC network, namely TS13, TS52, TS70, TS81 (Co. Kerry), TS67, TS68, TS78 (Co. Cork), TS91, TS121, TS124, TS125 (Co. Kerry). In particular, as no SACs are designated for *V. speciosa* in Co. Clare at present, this county should be considered a priority. Populations TS30 and TS78 in Co. Cork occur within good examples of 91A0 Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles habitat, which is another compelling reason for considering these sites for inclusion within the SAC network. It is not considered that new SACs should be designated based on the presence of gametophyte or gametophyte and juvenile sporophyte fronds only.

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Appendices

Appendix 1 – *Vandenboschia speciosa* Site survey card

Updated 2024

SITE SURVEY CARD – *Vandenboschia speciosa*
(population may include 1 or more colonies)

Surveyor(s):		Date:	
Population Name:		Population Code:	
County:	Survey type:	Monitoring	Baseline
Number colonies:		Population Generation:	

Land tenure: (Private, SAC, NAH, unknown)	Habitat type: (Woodland/Open Upland/Exposed Rock, etc)	Fossitt Hab:	Annex 1 Hab:
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Brief vegetation description:

Approx. extent of habitat (m²):	Approx. extent of population (m²):	Weather conditions:	Photos taken:
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Site description or changes since baseline:

Are there conservation measures in place in this location?
If yes, please give details:

Other remarks, including comments on condition/management/ongoing activities:

Site sketch (if necessary):	Indicate North

Appendix 2 – *Vandenboschia speciosa* Monitoring sheet

Updated 2024

Vandenboschia speciosa Field Monitoring Sheet (One per Colony)

Surveyor(s):	Date	SAC:
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Population Code:	Pop Name:	Colony Name/Number:	Generation:
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SECTION A – Monitoring of <u>sporophyte</u> direct attributes	
Sporophyte present (Y/N):	Grid reference (if possible):
Colony Area (m ²) (Measured as a rectangle, one measurement across the maximum dimension of the colony and another perpendicular to this):	Area of occupancy (%): (the greatest extent of the area of the colony within the rectangle occupied by <i>V. speciosa</i>)

Count or Estimate		Count	Estimate		
			Patch No. (25 x 25cm)	Patch No (25 x 25cm)	Patch No (25 x 25cm)
Frond Numbers	Mature sterile fronds (>50% green, fully expanded)				
	Fertile fronds				
	Young expanding (Still unfurling, not fully expanded)				
	*Young (previously juvenile from gametophytes. If unsure, then tick "Young expanding")				
	Croziers (beginning to unfurl)				
	Juvenile fronds (emerging from gametophytes, typically a simple frond)				
	Dying fronds (<50% green)				
	Dead fronds (blade ± intact, but frond all brown)				
Note: *Differ from typical young expanding fronds as they will start developing pinnae pairs rather than unfurling with them. Only complete if frond form clearly grown from previously juvenile from gametophyte).					

SECTION B – Monitoring of <u>gametophyte</u> direct attributes	
Gametophyte present (Y/N):	Grid reference (if possible):
COLONY / NICHE Area (m ²): (CIRCLE WHICH TYPE)(This may be a clearly defined colony. Or the niche in which numerous patches occur. This is equivalent to the maximum area)	Area of occupancy (%): <i>Visual estimate</i>
Brief description of colony (Dense, wefts, patchy, sparse, heavily interspersed with bryophytes)	Distance to nearest sporophyte:
Details (e.g. floor, walls, ceiling, rockface, LHS, RHS, Centre – it may be some or all of these):	

SECTION C – Monitoring of colony direct attributes							
Aspect:	Altitude:	Seasonal Flooding at colony: Y/N	Rock type:				
SUBSTRATE MOISTURE AT COLONY							
Visible water source Y/N:	*Water source:	Substrate damp/wet to touch Y/N					
*WATER SOURCE: 1 = Stream; 2 = River; 3 = Dripping Cave; 4 = Splash; 5 = Waterfall; 6 = Ground seepage; 7 = Rock seepage; 8 = Other							
SHADING OF COLONY:	Adequate shading (Y/N): (if no, give reason)						
*Note at woodland colonies, if shading provided by cave entrance, then score accordingly, e.g. 7 for a cave entrance)	*Woodland shading: (Target **shade index $\geq$ 4)						
	Open upland shading: (Target shade index $\geq$ 5)						
**SHADE INDEX: 1, Fully exposed to sunlight all day. 2, Sunlit for > half the day. 3, Significant sunlight, but for < half the day. 4, Moderate shade, e.g. light-medium deciduous canopy with sun flecks. 5, Permanently shaded from direct sunlight but otherwise open to sky. 6, Deep woodland (e.g. coniferous or in ravine) shade, no sun flecks. 7, Perpetual deep shade, e.g. cave entrance, beneath boulder, deep crevice)							
CANOPY COVER AT COLONY: (Woodland habitats only)	Adequate canopy cover (Y/N): (if no, give reason)						
For colonies occurring in cave entrances/deep crevices in woodlands, score the canopy cover provided to the opening of the cave/crevice to where the colony occurs	Canopy cover (Domin***): (Target Domin score $\geq$ 6)						
***DOMIN SCALE: + = < 1% with no measurable cover; 1 = < 1% 1 – 2 individuals, no measurable cover; 2 = < 1% with several individuals; 3 = 1 – 4%; 4 = 5 – 10%; 5 = 11 – 25%; 6 = 26 – 33%; 7 = 34 – 50%; 8 = 51 – 75%; 9 = 76 – 90% 10 = 91 – 100%							
OCCURRENCE OF VIGOROUS NATIVE SPECIES OR INVASIVE ALIEN SPECIES WITHIN AND/OR IN THE VICINITY OF SPOROPHYTE COLONIES AT VANDENBOSCHIA. SPECIOSA POPULATIONS							
Vigorous native species	*Impacting colony Y?N (Negative)	*Providing essential canopy cover/shade: Y/N (Positive)					
Species names:	Provide brief details:						
Invasive non-native species	*Impacting colony Y?N	*Providing essential canopy cover: Y/N					
Species names:	Provide brief details:						
Encroachment of bryophyte species in colonies where gametophytes occur: Y/N							
*Species may be having a positive or negative impact. Both options can be chosen. Provide brief details.							
The target is 'no obvious impact on colony'. If the IAS or vigorous native species is providing essential canopy cover, this would result in a pass for that indicator. If a negative impact is observed, such as bank slippage in the vicinity of the sporophyte colony, this would result in a fail for this indicator.							
OTHER IMPACTING ACTIVITIES:							
Bank slippage	Grazing	Tree fall	Flooding	Water pollution	Recreation	Chemicals	Burning
Other:				Extent of damage: No. of fronds damaged and/or area of colony affected (m ²)			
Notes on impact:							
Notes and Recommendations for management of colony, including conservation measures if needed.							

Appendix 3 – Assigning area of occupancy and frond numbers for unmonitored colonies

This appendix sets out the rationale and methodology used for assigning area of occupancy and frond numbers for unmonitored colonies where there is no information on file.

In order to derive a national area of occupancy and overall number of fronds for *V. speciosa* for the National Conservation Status Assessment (2019–2024), unmonitored colony records where there is no information on frond numbers or area were set a minimum value of 52 fronds and 0.22 m² area of occupancy for sporophyte colonies and 0.12 m² for gametophyte colonies, tabulated below.

SPOROPHYTES

For calculating an area of occupancy and frond number for unmonitored sporophyte colonies where there are no details of these available, average figures for these were calculated from figures recorded at monitored colonies, in order to assign a figure that was representative of a typical colony containing sporophytes. The following caveats applied when selecting monitored colonies from which to derive these figures.

- Colonies where actual frond counts were carried out were selected (colonies with estimated frond numbers were excluded). This totalled 64 colonies for this calculation. This ensured that the particularly large colonies were not included, as they would not be representative of typical colony sizes (e.g. large colonies at populations TS22, Co. Cork; TS25, Co. Cork; TS26, Co. Waterford and TS52, Co. Kerry).
- The combined area of occupancy for these 64 colonies was used to calculate an average area of occupancy to assign to unmonitored colonies.
- Juvenile-only colonies were excluded.

The areas of occupancy at the selected monitored colonies ranged from 0.002 m² to 1.9 m². Frond counts ranged from 1 to 364. The table below shows the calculations for deriving the figures to assign to unmonitored colonies with sporophytes where there are no details on area of occupancy or frond numbers.

Figures used to derive area of occupancy (m²) and frond numbers for unmonitored colonies where there are no details available (based on average figures for 64 monitored sporophyte colonies). These figures contributed to the overall frond number and area of occupancy figures included in the National Conservation Status Assessment (2019–2024) for all *V. speciosa* colonies.

No. of selected colonies	Total combined area of occupancy	Average area of occupancy to be assigned	Total combined frond counts	Average frond number to be assigned
64	14	0.22	3,332	52

GAMETOPHYTES

For calculating an area of occupancy for unmonitored gametophytes-only colonies where there are no details, an average for that measurement was calculated based on monitored colonies in order to assign a figure that was representative of a typical gametophytes-only colony. The following caveats applied when selecting from monitored colonies to derive this figure.

- Gametophyte colonies with an area of occupancy of $\leq 0.8 \text{ m}^2$ were selected, as the inclusion of larger gametophyte colonies would not be reflective of a typical gametophyte colony. This totalled 78 colonies for this calculation
- Colonies with juvenile sporophytes were excluded.

The areas of occupancy at the selected monitored gametophyte colonies ranged from 0.0006 m^2 to 0.8 m^2 . The table below shows the calculations for deriving the figures to assign to unmonitored gametophyte colonies where there are no details on area of occupancy.

Figures used to derive area of occupancy (m^2) for unmonitored gametophytes-only colonies where there are no details available (based on average figures for 78 monitored gametophyte colonies). These figures contributed to the overall area of occupancy figure included in the National Conservation Status Assessment (2019–2024) for all *V. speciosa* colonies.

No. of selected colonies	Total combined area of occupancy	Average area of occupancy to be assigned
78	9.4	0.12

Appendix 4 – Future prospects assessment for monitored populations

Future prospects (FP) assessments for the 49 *V. speciosa* populations surveyed and monitored between 2021 and 2024. F = Favourable; U-I = Unfavourable-Inadequate. None were assessed as Unfavourable-Bad. Pop. = population. Gen. = generations.

Pop. Code	County	Gen.	FP for Population	FP for Habitat for the species	Overall FP	Rationale
TS01	Tipperary /Limerick	SGJ	F	F	F	Reduction in frond numbers at TS01.01.01 is most likely due to natural turnover. The colony appears in good health. TS01.02.05 was difficult to access and view. The slope has revegetated since the last reporting period. No pressures observed. At TS01.03.04 juvenile sporophytes were not re-found. No pressures were identified. PF05 (Sports, tourism, and leisure activities) is considered a low impact at colony TS01.02.01. The bank where this colony occurs is near a docking area for kayakers. PM01 and PJ07 (Storm or cyclone) causing treefall was considered a low impact to the colonies at present.
TS05	Kerry	S	F	F	F	Mixed source pollution (PK01) was recorded but is considered a low impact at present. Flooding (PM02) is a threat to S colony TS05.01.01 which occurs on the side of a waterfall and could potentially be dislodged in extreme weather. Currently considered a low impacting activity.
TS07	Carlow	SGJ	F	F	F	No impacting activities at this location.
TS08	Cork	S&G	F	U-I	U-I	Loss of canopy cover at colony TS08.01.02 reported in the previous reporting period remains a medium impacting activity. There was evidence of impact on one colony due to treefall resulting from storms (PM01 and PJ07) that occurred in the previous reporting period (see Habitat for the species assessment for details). With the increase in extreme weather events, this may become a major impact for many populations in the future if essential canopy cover is lost or if falling trees directly damage colonies. PM05 (Avalanches, landslides and collapse of terrain) was considered a low impact at this population.
TS09	Kerry	S&G	F	F	F	Grazing (PA07) within the area, but no evidence of impact on sporophyte colony TS09.01.01. The invasive alien species (PI02) <i>Epilobium brunnescens</i> recorded in this location is not currently being recorded as a threat to the species or habitat.

Pop. Code	County	Gen.	FP for Population	FP for Habitat for the species	Overall FP	Rationale
TS10	Kerry	S&G	U-I	F	U-I	Fronds were flushed out of the crevice, likely due to a strong flow of water during heavy rain (Flooding, PM02). This resulted in some being exposed. There was a significant reduction in colony area of occupancy and frond numbers. The rhizome was still intact, and it is likely that there are fronds remaining inside the crevice; however, it was difficult to assess this due to weather conditions. This colony will need to be monitored going forward. There was a reduction in maximum area of gametophyte colony. There is no obvious pressure. The invasive alien species (PI02) <i>Epilobium brunnescens</i> recorded in this location is not currently being recorded as a threat to the species or habitat.
TS11	Kerry	S&G	F	F	F	Frequency of extremes in weather conditions and flooding (PM02) is a threat to S colony TS11.01.01 which occurs beneath a boulder in a stream and could potentially be dislodged in an extreme weather event. It is currently a low impacting activity.
TS13	Kerry		F	F	F	No impacting activities.
TS14	Kerry	SGJ	U-I	U-I	U-I	Although natural turnover may account for some of the reduction in area and fronds, there appears to be a pressure on frond numbers due to problematic native species (PI03) that are becoming problematic for this colony (<i>Hedera hibernica</i> and <i>Saxifraga hirsuta</i>). It is likely that the two encroaching species are responding to the relatively open canopy. PM05 (Avalanches, landslides and collapse of terrain) was considered a low impact at this population.
TS15	Kerry	SGJ	F	F	F	No impacting activities at this location.
TS16	Limerick	S&G	F	F	F	Although the threat of fire (burning down) was highlighted, the impact of this activity is considered low at present. <i>Hedera hibernica</i> was recorded encroaching on sporophytes close to the opening holding the species. This is not currently a significant impact but should be monitored in future.
TS17	Sligo	S&G	F	F	F	Grazing (PA07) within the area, but no evidence of impact on S&G colony. <i>Acaena ovalifolia</i> was recorded in this population; however, the impact, if any, of this species on the <i>V. speciosa</i> population is unknown. This species is reported as a medium impact species in a report on Ireland's invasive and non-native species (O'Flynn <i>et al.</i> , 2014).
TS19	Kerry	S&G	F	F	F	PF05 (Sports, tourism, and leisure activities) is considered a low impact at TS19. Colony TS19.01.01 is very close to a popular well-used path.

Pop. Code	County	Gen.	FP for Population	FP for Habitat for the species	Overall FP	Rationale
TS20	Limerick	S&G	F	F	F	The invasive alien species (PI02) <i>Rhododendron ponticum</i> was considered to be having a low impact on <i>V. speciosa</i> sporophytes at present but has the potential to impact the Habitat for the species if left unchecked. PM01 and PJ07 (Storm or cyclone) causing treefall blocked access to three colonies but was considered a low impact to the colonies at present.
TS21	Donegal	S&G	F	F	F	No impacting activities at this location.
TS22	Cork	SGJ	U-I	F	U-I	Colony TS22.01.02, which supported young and juvenile sporophytes, was significantly impacted by invasive alien species (PI02) causing bank slippage (PM05) due most likely to <i>Prunus laurocerasus</i> slipping down. This was considered a medium impacting activity for the population. At TS22.01.04. the problematic native species (PI03) <i>R. fruticosus</i> agg. is engulfing the sporophytes within this colony. Although providing essential canopy cover, it is rooting into the bank where sporophytes are growing.
TS23	Donegal	SGJ	F	F	F	Flooding (PM02) is a threat to this colony, however it is currently considered a low impact.
TS24	Kerry	SGJ	F	F	F	PF05 (Sports, tourism, and leisure activities) is considered a low impact at TS24 colonies beneath the waterfall and along the riverbank. The colonies are close to a popular well-used path. <i>R. ponticum</i> and <i>P. laurocerasus</i> occur throughout this population, providing essential shade to many colonies. Although these species may negatively impact the habitat where the colonies occur, there was no evidence to suggest that the extent or quality of the habitat for the species has changed significantly in the recent past. PM05 (Avalanches, landslides and collapse of terrain) was considered a low impact at this population. PM01 and PJ07 (Storm or cyclone) causing treefall blocked access to a number of colonies but was considered a low impact to the colonies at present.
TS25	Cork	S&G	U-I	U-I	U-I	At colony TS25.01.02, there was an apparent significant reduction in the sporophyte area of occupancy due to the problematic native species (PI03) <i>Rubus fruticosus</i> agg. Although some of the difference in AoO and frond numbers may be due to the difficulties of obtaining precise measurements and counts, the magnitude of the difference suggests that a genuine decline has occurred. <i>R. fruticosus</i> agg. which is engulfing one colony, is now beginning to encroach on sporophytes in the adjacent colony.
TS26	Waterford	SGJ	U-I	U-I	U-I	The invasive alien species (PI02) <i>P. laurocerasus</i> is problematic throughout a significant proportion of this population. Colony TS26.01.19 was inaccessible during the current reporting period. It received an Unfavourable–Inadequate conservation assessment in 2013–2018 due to loss of area and frond numbers as a result of <i>P. laurocerasus</i> causing

Pop. Code	County	Gen.	FP for Population	FP for Habitat for the species	Overall FP	Rationale
						bank slippage (PM05) and remains U-I for 2019-2024. The colony was inaccessible, but the habitat appeared unchanged since the last visit. TS26.01.21 had a reduction in sporophyte area of occupancy and frond numbers. The pressure was not clear, but an impact was evident. This should be monitored in the future. PM01 and PJ07 (Storm or cyclone) causing treefall blocked access to three colonies but was considered a low impact to the colonies at present. <i>Reynoutria japonica</i> occurs in the vicinity of S&G colonies TS26.01.01 and TS26.01.03 but is not regarded as a threat to <i>V. speciosa</i> . PM01 and PJ07 (Storm or cyclone) causing treefall blocked access to a number of colonies but was considered a low impact to the colonies at present.
TS30	Cork	S&G	F	F	F	Grazing (PA07) was noted within the area, but there was no evidence of impact on the S&G colony. The landowner has grazed Dexter cattle in the woodland and has taken pre-emptive steps to protect a large colony supporting sporophytes by erecting a fence around that colony. The invasive alien species <i>Sasa</i> sp. (PI02) is being managed by the landowner.
TS32	Kerry	S	F	F	F	No impacting activities.
TS36	Kerry	G	F	F	F	No impacting activities.
TS40	Kerry	S	F	F	F	Flooding (PM02) is a threat at this population, however it is currently considered a low impact.
TS43	Waterford	SGJ	F	F	F	Flooding (PM02) is a threat at this population, however it is currently considered a low impact.
TS44	Cork	SG	F	F	F	The invasive alien species (PI02) <i>Epilobium brunnescens</i> recorded in this location is not currently being recorded as a threat to the species or habitat.
TS48	Kerry	SG	F	F	F	No impacting activities.
TS49	Kerry	SG	F	F	F	<i>Rhododendron ponticum</i> (PI02) was considered to be having a low impact on <i>V. speciosa</i> colonies at present. There was evidence of control of this invasive alien species, however it was not considered to be impacting the colonies in this population.
TS53	Kerry	GJ	F	F	F	No impacting activities.

Pop. Code	County	Gen.	FP for Population	FP for Habitat for the species	Overall FP	Rationale
TS54	Kerry	SG	F	F	F	Mixed source pollution (PK01) was recorded but is considered a low impact at present. Flooding (PM02) is a threat to this colony, however it is currently considered a low impact. The invasive alien species (PI02) <i>Epilobium brunnescens</i> recorded in this location is not currently being recorded as a threat to the species or habitat.
TS56	Wicklow	G	F	F	F	Flooding (PM02) is a threat, however it is currently considered a low impact.
TS58	Kerry	G	F	F	F	No impacting activities.
TS59	Kerry	S	F	F	F	Mixed source pollution (PK01) was recorded but is considered a low impact at present. Flooding (PM02) is a threat, however it is currently considered a low impact.
TS62	Waterford	G	F	F	F	No impacting activities.
TS63	Waterford	G	F	F	F	No impacting activities.
TS64	Kerry	S	F	F	F	Flooding (PM02) is a threat, however it is currently considered a low impact.
TS66	Kerry	SG	F	F	F	No impacting activities.
TS67	Cork	SGJ	F	F	F	PB26 (Other forestry activities (e.g. pruning)) is considered a low impact at this population, where there was woodland clearance in the vicinity.
TS68	Cork	SGJ	F	F	F	PF05 (Sports, tourism, and leisure activities) is considered a low impact at this population which is located in an easily accessible location at the back of a garden of a private home.
TS69	Kerry	SGJ	F	F	F	PB17 (Use of biocides) was recorded at one colony (TS69.01.01) with evidence that the chemical leaked into the crevice where a <i>V. speciosa</i> gametophyte-only colony occurs. However, there was no evidence that the colony has been impacted. PB26 (Other forestry activities (e.g. pruning)) was considered a low impact at TS66.01.02. This colony was newly discovered during <i>R. ponticum</i> pruning. PF05 (Sports, tourism, and leisure activities) is considered a low impact at colony TS69.01.02, which is very close to a popular well-used path. <i>Rhododendron ponticum</i> (PI02) was considered to be having a low impact on <i>V. speciosa</i> colonies at present.
TS71	Kerry	GJ	F	F	F	<i>Rhododendron ponticum</i> (PI02) was considered to be having a low impact on <i>V. speciosa</i> sporophytes at present.
TS72	Kerry	SGJ	F	F	F	No impacting activities.

Pop. Code	County	Gen.	FP for Population	FP for Habitat for the species	Overall FP	Rationale
TS73	Kerry	G	F	F	F	No impacting activities.
TS77	Wexford	SGJ	F	F	F	Flooding (PM02) is a threat at colonies TS77.01.01–TS77.01.05, however it is currently considered a low impact.
TS78	Cork	SGJ	F	F	F	The invasive alien species (PI02) <i>Epilobium brunnescens</i> recorded in this location is not currently being recorded as a threat to the species or habitat.
TS79	Kerry	G	F	F	F	No impacting activities.
TS80	Cavan	G	F	F	F	Mixed source pollution (PK01) was recorded but is considered a low impact at present.
TS81	Kerry	SGJ	F	F	F	<i>Rhododendron ponticum</i> (PI02) was considered to be having a low impact on <i>V. speciosa</i> sporophytes at present.
TS85	Kerry	G	F	F	F	No impacting activities.

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