European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC)

Fourth Report by the United Kingdom under Article 17

on the implementation of the Directive
from January 2013 to December 2018

Supporting documentation for the
conservation status assessment for the species:

S6985 - Killarney fern (*Vandenboschia speciosa*)

WALES

IMPORTANT NOTE - PLEASE READ

- The information in this document is a country-level contribution to the UK Report on the conservation status of this species, submitted to the European Commission as part of the 2019 UK Reporting under Article 17 of the EU Habitats Directive.
- The 2019 Article 17 UK Approach document provides details on how this supporting information was used to produce the UK Report.
- The UK Report on the conservation status of this species is provided in a separate document.
- The reporting fields and options used are aligned to those set out in the European Commission guidance.
- Explanatory notes (where provided) by the country are included at the end. These provide an audit trail of relevant supporting information.
- Some of the reporting fields have been left blank because either: (i) there was insufficient information to complete the field; (ii) completion of the field was not obligatory; (iii) the field was not relevant to this species (section 12 Natura 2000 coverage for Annex II species) and/or (iv) the field was only relevant at UK-level (sections 9 Future prospects and 10 Conclusions).
- For technical reasons, the country-level future trends for Range, Population and Habitat for the species are only available in a separate spreadsheet that contains all the country-level supporting information.
- The country-level reporting information for all habitats and species is also available in spreadsheet format.

Visit the JNCC website, https://jncc.gov.uk/article17, for further information on UK Article 17 reporting.

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

NATIONAL LEVEL

1. General information

1.1 Member State	**UK (Wales information only)**
1.2 Species code	**6985**
1.3 Species scientific name	**Vandenboschia speciosa**
1.4 Alternative species scientific name	
1.5 Common name (in national language)	Killarney fern

2. Maps

2.1 Sensitive species	No
2.2 Year or period	1990-2017
2.3 Distribution map	Yes
2.4 Distribution map Method used	Based mainly on extrapolation from a limited amount of data
2.5 Additional maps	No

3. Information related to Annex V Species (Art. 14)

3.1 Is the species taken in the wild/exploited?		No
3.2 Which of the measures in Art. 14 have been taken?	a) regulations regarding access to property	No
	b) temporary or local prohibition of the taking of specimens in the wild and exploitation	No
	c) regulation of the periods and/or methods of taking specimens	No
	d) application of hunting and fishing rules which take account of the conservation of such populations	No
	e) establishment of a system of licences for taking specimens or of quotas	No
	f) regulation of the purchase, sale, offering for sale, keeping for sale or transport for sale of specimens	No
	g) breeding in captivity of animal species as well as artificial propagation of plant species	No
	h) other measures	No

Report on the main results of the surveillance under Article 11 for Annex II, IV and V species (Annex B)

3.3 Hunting bag or quantity taken in the wild for Mammals and Acipenseridae (Fish)

a) Unit

b) Statistics/ quantity taken	Provide statistics/quantity per hunting season or per year (where season is not used) over the reporting period					
	Season/ year 1	Season/ year 2	Season/ year 3	Season/ year 4	Season/ year 5	Season/ year 6
Min. (raw, ie. not rounded)						
Max. (raw, ie. not rounded)						
Unknown	No	No	No	No	No	No

3.4. Hunting bag or quantity taken in the wild Method used

3.5. Additional information

BIOGEOGRAPHICAL LEVEL

4. Biogeographical and marine regions

4.1 Biogeographical or marine region where the species occurs

Atlantic (ATL)

4.2 Sources of information

Botanical Society of Britain & Ireland distribution database, https://database.bsbi.org/
Chater, A.O. 2010. Flora of Cardiganshire. Aberystwyth. 798pp.
Gibby, M. 1997. Workshop on Trichomanes speciosum, the Killarney fern. Confidential report of proceedings. (Unpublished) Natural History Museum. London. WILLD.AND I
Natural England, RSPB. 2014. Climate Change Adaptation Manual.
NRW. 2013. Supporting documentation for the Third Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2007 to December 2012 Conservation status assessment for species: S1421 - Killarney fern (Trichomanes speciosum).
Ratcliffe, D.A. Birks, Birks H.J.B., Birks Hilary H. The Ecology and conservation of the Killarney Fern Trichomanes speciosum WILLD. In Britain and Ireland. Biological Conservation 66 (1993) 231 -247.
Ratcliffe, D.A. 2000. In Search of Nature. Peregrine Press.
Rumsey, F.J., Farrar, D.R. & Sheffield, E. 1990. Filmy fern gametophytes in the British Isles. Pteridologist 2: 40-42.
Rumsey, F.J. Jermy, A.C. 1998. The independent gametophytic stage of Trichomanes speciosum Willd. (Hymenophyllaceae), the Killarney Fern and its distribution in the British Isles. Watsonia 22: pages 1 - 19
Rumsey, F.J. 2012. Vandenboschia speciosa (Killarney fern) http://www.nhm.ac.uk/nature-online/species-of-the-day/biodiversity/endangered-species/vandenboschia-speciosa/index.html
Rumsey, F.J. 2017. A review and analysis of the sporophyte generation of the Killarney fern Vandenboschia speciosa (Willd.) Kunkel (syn. Trichomanes

specisosum Wild.) in Wales. Confidential report to NRW.
'Sentinel' (2003) Killarney Fern Conservation. Pteridologist 4 (2) pp58-61
Schuler, S. B-M. et al. Genetic diversity and population history of the Killarney fern, Vandenboschia speciosa (Hymenophyllaceae), at its southern distribution limit in continental Europe. Botanical Journal of the Linnean Society, Volume 183, Issue 1, 1 January 2017, Pages 94-105.

5. Range

5.1 Surface area (km²)		
5.2 Short-term trend Period		
5.3 Short-term trend Direction	Stable (0)	
5.4 Short-term trend Magnitude	a) Minimum	b) Maximum
5.5 Short-term trend Method used		
5.6 Long-term trend Period		
5.7 Long-term trend Direction		
5.8 Long-term trend Magnitude	a) Minimum	b) Maximum
5.9 Long-term trend Method used		
5.10 Favourable reference range	a) Area (km²) b) Operator c) Unknown d) Method	
5.11 Change and reason for change in surface area of range	Improved knowledge/more accurate data The change is mainly due to:	Improved knowledge/more accurate data
5.12 Additional information		

6. Population

6.1 Year or period	2013-2017	
6.2 Population size (in reporting unit)	a) Unit b) Minimum c) Maximum d) Best single value	number of individuals (i) 17
6.3 Type of estimate	Best estimate	
6.4 Additional population size (using population unit other than reporting unit)	a) Unit b) Minimum c) Maximum d) Best single value	number of map 10x10 km grid cells (grids10x10) 58
6.5 Type of estimate	Best estimate	
6.6 Population size Method used	Complete survey or a statistically robust estimate	
6.7 Short-term trend Period	2007-2018	

6.8 Short-term trend Direction	Stable (0)
6.9 Short-term trend Magnitude	a) Minimum b) Maximum c) Confidence interval
6.10 Short-term trend Method used	Based mainly on extrapolation from a limited amount of data
6.11 Long-term trend Period	
6.12 Long-term trend Direction	
6.13 Long-term trend Magnitude	a) Minimum b) Maximum c) Confidence interval
6.14 Long-term trend Method used	
6.15 Favourable reference population (using the unit in 6.2 or 6.4)	a) Population size b) Operator c) Unknown d) Method
6.16 Change and reason for change in population size	Improved knowledge/more accurate data The change is mainly due to: Improved knowledge/more accurate data
6.17 Additional information	

7. Habitat for the species

7.1 Sufficiency of area and quality of occupied habitat	a) Are area and quality of occupied habitat sufficient (to maintain the species at FCS)?	Yes
	b) Is there a sufficiently large area of occupied AND unoccupied habitat of suitable quality (to maintain the species at FCS)?	
7.2 Sufficiency of area and quality of occupied habitat Method used	Based mainly on extrapolation from a limited amount of data	
7.3 Short-term trend Period	2007-2018	
7.4 Short-term trend Direction	Stable (0)	
7.5 Short-term trend Method used	Based mainly on expert opinion with very limited data	
7.6 Long-term trend Period		
7.7 Long-term trend Direction		
7.8 Long-term trend Method used		
7.9 Additional information		

8. Main pressures and threats

8.1 Characterisation of pressures/threats

Threat	Ranking
Agricultural activities generating air pollution (A27)	M

Hydropower (dams, weirs, run-off-the-river), including infrastructure (D02)	M
Mixed source pollution to surface and ground waters (limnic and terrestrial) (J01)	M
Droughts and decreases in precipitation due to climate change (N02)	M

8.2 Sources of information

8.3 Additional information

9. Conservation measures

9.1 Status of measures

a) Are measures needed? Yes

b) Indicate the status of measures Measures identified, but none yet taken

9.2 Main purpose of the measures taken

9.3 Location of the measures taken

9.4 Response to the measures

9.5 List of main conservation measures

9.6 Additional information

10. Future prospects

10.1 Future prospects of parameters

a) Range

b) Population

c) Habitat of the species

10.2 Additional information

11. Conclusions

11.1. Range

11.2. Population

11.3. Habitat for the species

11.4. Future prospects

11.5 Overall assessment of Conservation Status

11.6 Overall trend in Conservation Status

11.7 Change and reasons for change in conservation status and conservation status trend

a) Overall assessment of conservation status

No change

The change is mainly due to:

b) Overall trend in conservation status

No change

	The change is mainly due to:
11.8 Additional information	

12. Natura 2000 (pSCIs, SCIs and SACs) coverage for Annex II species

12.1 Population size inside the pSCIs, SCIs and SACs network (on the biogeographical/marine level including all sites where the species is present)	a) Unit	number of colonies (colonies)
	b) Minimum	
	c) Maximum	
	d) Best single value	6
12.2 Type of estimate	Best estimate	
12.3 Population size inside the network Method used	Complete survey or a statistically robust estimate	
12.4 Short-term trend of population size within the network Direction	Stable (0)	
12.5 Short-term trend of population size within the network Method used	Based mainly on extrapolation from a limited amount of data	
12.6 Additional information		

13. Complementary information

13.1 Justification of % thresholds for trends	
13.2 Trans-boundary assessment	
13.3 Other relevant Information	

Distribution Map

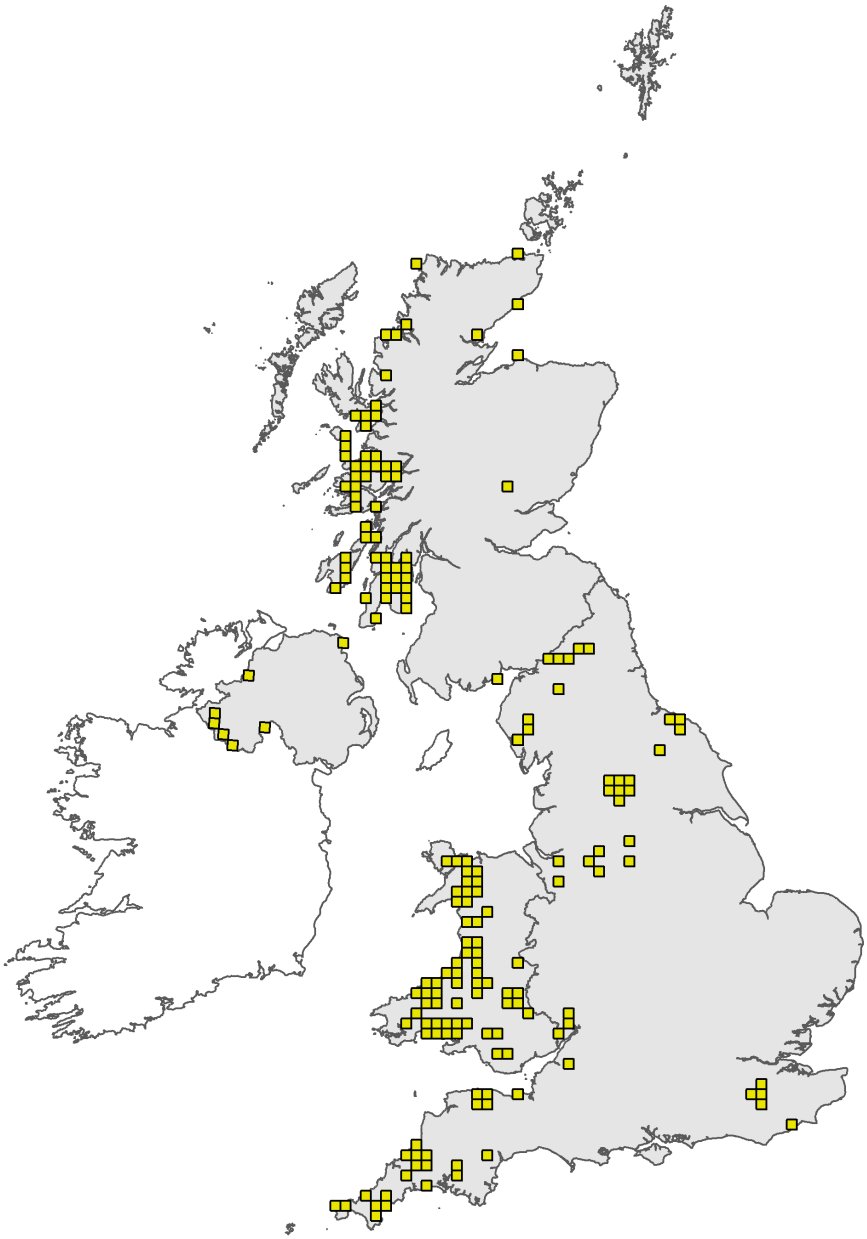

Figure 1: UK distribution map for S6985 - Killarney fern (*Vandenboschia speciosa*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

The 10km grid square distribution map is based on available species records within the current reporting period. For further details see the 2019 Article 17 UK Approach document.

Range Map

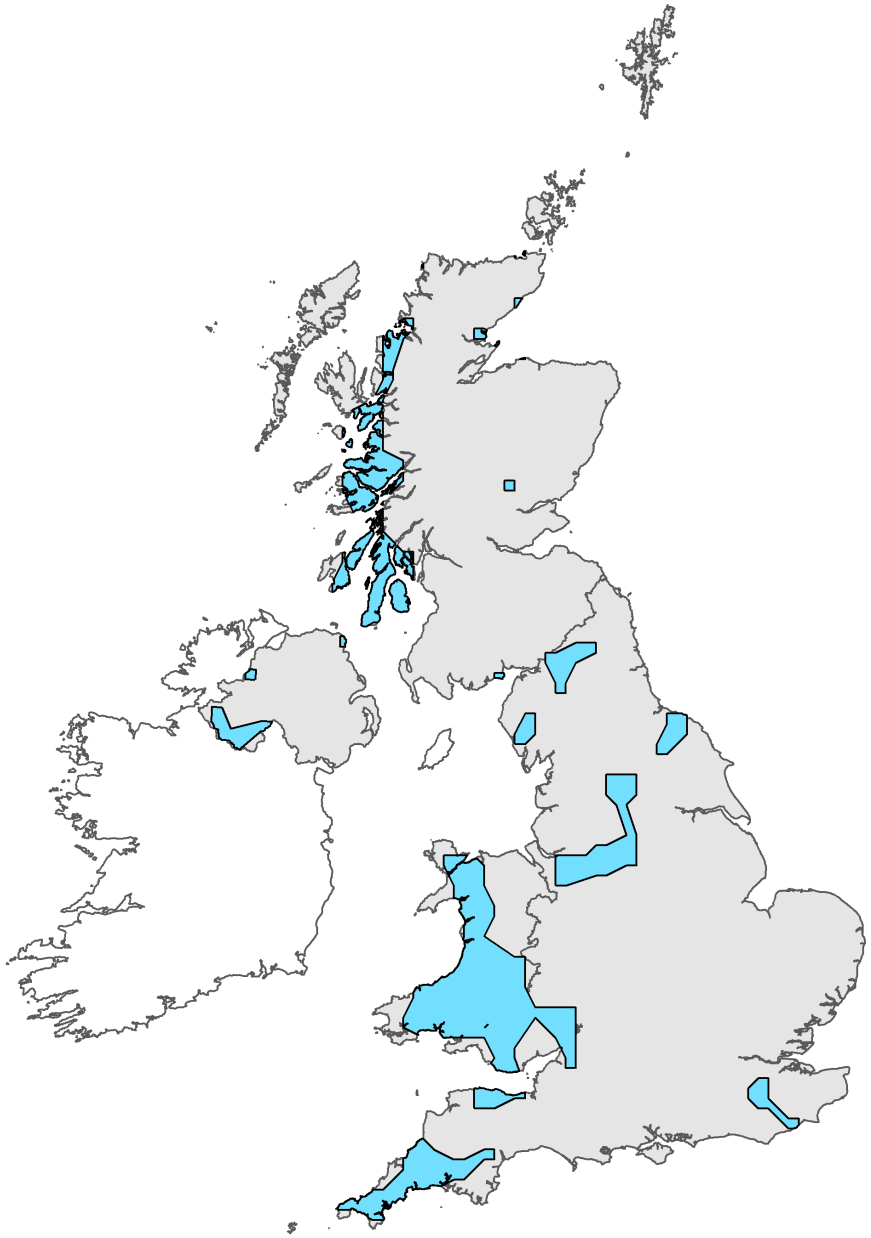

Figure 2: UK range map for S6985 - Killarney fern (*Vandenboschia speciosa*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

The range map has been produced by applying a bespoke range mapping tool for Article 17 reporting (produced by JNCC) to the 10km grid square distribution map presented in Figure 1. The alpha value for this species was 20km. For further details see the 2019 Article 17 UK Approach document.

Explanatory Notes

Species name: Vandenboschia speciosa (6985)

Field label	Note
2.1 Sensitive species	While locations are not considered confidential at the 10km scale the perceived threat posed by collection means that there is some effort in keeping the exact locations of the sporophyte generation confidential.
2.4 Distribution map; Method used	Locations for the sporophyte are well known (Rumsey 2017) and localised. The gametophyte is more widespread and there has been a steady accumulation of locations since the identification and technique for searching for the gametophyte has become better understood (Rumsey 1998). The gametophyte is still probably under-recorded, but this level of under-recording may well plateau soon.

Species name: Vandenboschia speciosa (6985) Region code: ATL

Field label	Note
5.3 Short term trend; Direction	See 6.8
5.11 Change and reason for change in surface area of range	Changes to the reported 10km square distribution in Wales and the resultant range map mostly arise from the inclusion of newly identified localities for the gametophyte. In the absence of comprehensive and repeated surveys for the gametophyte genuine changes to the underlying distribution cannot be discounted.
6.2 Population size	17 (colonies) Estimates of the population size for Vandenboschia are not straight forward and could potentially be based on a number of different parameters. The sporophyte is known from six sites in Wales. These sites support a total of 17 discrete colonies (the unit most closely related to the standard EU reporting unit of individuals) of variable size (Rumsey 2017). The combined total of live fronds, summed from the most recent visits to all Welsh colonies, is estimated at just over 2200, although exact counts at some sites are difficult and subject to natural fluctuations. The gametophyte is much more widespread, and its exact distribution is less well understood and documented. Quantifying the population of this life stage is therefore not simple and is subject to significant uncertainties. The most repeatable and reliable measure of the gametophyte population currently available is the 10km square count, which currently stands at 58.
6.4 Additional population size	58 (10km squares) Vandenboschia (sporophytes and/or gametophytes) have been recorded from 58 separate hectads (10 x 10 km squares) in Wales (Botanical Society of Britain & Ireland distribution database, Rumsey 2017).
6.6 Population size; Method used	All of the known localities for Vandenboschia speciosa sporophytes are visited on a regular basis by either NRW staff, local botanists or the relevant site guardian. The most recent assessments of these populations, summarised in Rumsey 2017, include an assessment of the number of discrete colonies and (in all but one case) an assessment of the number of live fronds. The distribution of the gametophyte in Wales is less well understood and monitored. The current hectad count is derived from data held in the BSBI database and from NRW records and is based on records provided by a range of both professional and amateur botanists. The life stage and its preferred habitat in the UK was first described less than 30 years ago (Rumsey et al. 1990) and its inconspicuous nature and relatively inaccessible habitat means that it is likely to remain under-recorded in Wales (Rumsey 2017).

6.8 Short term trend; Direction	The short-term trend in population size is best considered stable. The overall increase in the reported hectad distribution of the gametophyte is mostly the result of the discovery of new, but presumably established colonies, rather than any significant spread of the life stage, which almost certainly remains under recorded, at least in some parts of Wales. There have been no recent losses or gains in the number of known localities for the sporophyte in Wales. Rumsey (2017) reports mixed trends in the numbers of live fronds recorded at individual sites, with the count at one site increasing, two remaining relatively stable, two fluctuating with no clear trend and one decreasing.
6.10 Short term trend; Method used	The assessment of trend in population size is based on consideration of several different parameters for which different amounts and quality of data are available. Sites for the sporophyte generation are regularly visited by recorders, and while some aspects of population size (notably live frond count and to a lesser extent number of discrete colonies) are difficult to assess consistently at some less accessible sites, most are subject to relatively comprehensive recording. Sites for the gametophyte generation are not subject to any organised, routine surveillance and it is likely to remain under-recorded in some areas.
6.16 Change and reason for change in population size	The change in reported population size in field 6.4 (alternative population unit) is mostly the result of the discovery of additional, but presumably already established colonies of the gametophyte. Other less significant changes to the underlying hectad distribution derive from the addition of a known but previously undisclosed sporophyte site.
6.17 Additional information	This information corresponds to Evidence Pack section 6.18. The age structure of individual populations of Vandenboschia in Wales is unusual, at least in comparison to many other plant species, with most populations consisting only of the gametophyte generation and occupying micro-habitats relatively unsuitable for the development of the sporophyte. Of the six known localities for the sporophyte three have never been known to produce fertile fronds, and recruitment of new sporophytes has only been observed at one in recent years, although all either occur in close association with or relatively near to colonies of the gametophyte (Rumsey 2017). However, there is no indication this is not the normal population structure in Wales

8.1 Characterisation of pressures/ threats	Pressures: Forestry activitities (B09, B27), including altered shade, nutrient systems and hydrology would potentially represent a greater threat, especially to the gametophyte habitat but there is insufficient evidence (apart from the scarcity of gametophyte populations in commercial forestry) to consider them as any more than Low pressure. I04, problematic native species (especially Hedera helix subspecies hibernica and Rubus fruticosus agg.) were considered to represent a greater risk to populations in the 2012 article 17 report (NRW 2013). However more recently Rumsey (2017) observed that 'as a species successfully adapted to growth in very low light levels and to receive much/most of its nutrition through its foliage and therefore not from the competitive environment of the soil I believe that there is little evidence that the Trichomanes (Vandenboschia) sporophyte would suffer from interspecific competition, particularly when growing in optimal conditions' and on the strength of this I04 is considered to be only a low pressure here. Climate change, notably increases in the frequency and severity of summer droughting (N02) (Natural England & RSPB 2014) may represent a significant risk to some established populations of Killarney fern sporophytes. There is however little evidence of any current adverse impacts and it is considered to represent only a low current pressure. D02, Hydroelectric power schemes, and to a lesser extent other activities that change the flow of water (K04) represent a significant risk to populations through alteration of the ambient moisture levels in their ravine habitat. The pressure and threat level is considered low at all sites due to the present level of protection and regulation of hydroelectric schemes. Any lowering or removal of present level of protection and regulation would increase the level of threat from these activities for sporophyte populations and possibly some gametophyte populations. There used to be an abstraction up stream from the Carmarthenshire site that ceased some years ago. A27, excess deposition of reactive Nitrogen, notably from intensive agricultural production (chicken and dairy) is increasingly recognised as an issue adversly impacting species and habitats on sites across Wales. Although there is at present no direct evidence of impacts on Vandenboschia, this species, which recieves much of its nutrition directly through its foliage (Rumsey 2017), is potentially very vulnerable to dry deposition of Ammonia through direct toxicity. Net enrichment by nutrient nitrogen, which favours more competitive species, may also represent a risk to some populations. F09, Deposition and treatment of waste/garbage fromhousehold/recreational facilities;I02 other invasive alien species; J01, mixed source pollution to surface and ground waters;and L01, abiotic natural processes (e.g. erosion, silting up, drying out, submersion, salinization), have all been identified as issues at the only unprotected (non-SSSI) sporophyte site in Wales (S. Bosanquet, pers comm.).Here there has been and continues to be a threat from fly-tipping into the site from an adjacent road (F09). This has led in the recent past to alteration of the stream bed and silting up / deposition of silt (L01) over colonies of the Killarney Fern sporophyte.: There is also an ongoing pressure and continued threat from populations of non-native plant species (Galeobdolon luteum and Lonicera nitida) (I02).This site is surrounded by agricultural land and upstream there is a slurry store and sewage treatment works. There is no evidence of any adverse impacts from these sources but they remains a significant threat and any unexpecting release from either installation could have a dramatic negative impact to the site and the population of Killarney fern here. All of the above pressures are considered to be low at the scale of welsh population as a whole but I02 is identified as a Medium threat given the potentially catestrophic consequences of any accidental discharge on what is a key site for the species. Threats: All of the pressures listed above are considered to be ongoing and are expected to represent a continuing threat to the conservation status of the species over the next 12 years. Also see specific comments about ongoing threats to the Carmartheshire site above. Collecting pressures (G11) have been widely considered to represent the greatest threat to Killarney fern sporophytes in the UK and are believed to have eradicated at least five British colonies, as well as uncounted populations in Ireland (Ratcliffe 2000). However the locations of at least two populations of the

	sporophyte are widely known within the botanical community and neither appears to have suffered any deliberate damage in recent years nor is there any evidence of recent collection from any of the other welsh localities. As such while collection is considered to be only a low threat it is not included as a pressure. Any alterations to the flow and chemical composition of the water, and to the microclimate, in the habitats of this fern are likely to be inimical to its survival (D02 K04), as through tree removal, hydro-electric developments and other water extraction. The natural random scouring of ravines by stream torrents under flood conditions can be aggravated by human interference within catchments. One small colony was lost during the intense frosts of early 1963, but probably after human activity had previously reduced its vigour. The Pembrokeshire population was severely damaged during the winter of 2011/12
9.5 List of main conservation measures	Five of the 6 known sporophyte populations are in SACs and/or Sites of Special Scientific Interest and at least 25% of the known major gametophyte colonies are similarly protected (NRW 2013). Small areas of forestry have also been managed to potentially improve the habitat for this species (CB02), inside and outside the protected sites network (mainly by removal of non-native conifers). Emmissions of reactive atmospheric nitrogen are controlled by both national and international regulations and more local planning controls. These regulations and other controls cover larger individual agricultural emitters but smaller emitters are largely unregulated (CA12). Reducing problematic native species through direct management may be required on some sites (CI05 & CS03). Recently improved regulation of hydropower schemes and presence of many of the sporophyte colonies within protected sites should Should limit any adverse impacts from these developments, although undiscovered and/or undisclosed colonies will remain at risk (CC04) Some work to reduce the impact of invasive non-native species (CI03) has been undertaken at one site. This may require further action.
10.1 Future prospects of parameters	10.1a Future prospects of -range. Future trend: overall stable While ongoing survey work may reveal further records extending the known distribution of the gametophyte, it is considered unlikely that there will be any significant change in the actual distribution (and associated range) of Vandenboschia in Wales over the next twelve years.10.1b Future prospects of -PopulationThe overall trend in the population of Vandenboschia in Wales is likely to at least remain stable over the next twelve years. Existing populations of the sporophyte and gametophyte are fully protected from deliberate damage under the Wildlife and Countryside Act and the majority are included within the protected sites series. Threats, are in the main limited and/or largely offset by existing conservation measures. However, given the tiny number of individual colonies of the sporophyte there is the potential for chance events to have catastrophic impacts, for example more exposed colonies of the sporophyte remain vulnerable to frost damage in severe winters and the survival of one remains in the balance following the winter of 2011/12. 10.1c Future prospects of -Habitat of the species The overall trend in the habitat of Vandenboschia in Wales is likely to at least remain stable over the next twelve years. Threats, are in the main limited and/or largely offset by existing conservation measures.
12.1 Population size inside the pSCIs, SCIs and SACs network	Vandenboschia is a recognised feature of three SACs in Wales, all of which support colonies of the sporophyte. The sporophyte is also known from a fourth welsh SAC, although the secrecy surrounding this location resulted in it not being identified as a qualifying feature of the site at the point of designation. In total these four sites hold six discrete patches of the sporophyte (colonies) and (according to the most recent count data) include some 1440 live fronds.

12.3 Population size inside the network; Method used	All of the known localities for Vandenboschia speciosa sporophytes on SACs in Wales are visited on a regular basis by either NRW staff or local botanists. The most recent assessments of these populations, summarised in Rumsey 2017, include an assessment of the number of discrete colonies and (in all but one case) an assessment of the number of live fronds.
12.4 Short term trend of the population size within the network; Direction	The overall trend in the population of Vandenboschia (sporophyte) within the welsh N2K series is comparatively stable. Fluctuations in the size and number of live fronds associated with individual colonies have been observed over both the long- and short-term, with severe winters adversely impacting the size and vigour of individual patches, but these are not considered to show any overall trend. There has been no comprehensive surveillance or monitoring of the gametophyte within welsh SACs, but at present there is no reason to suspect an ecologically significant trend in the overall 'population size' of this lifestage.
12.5 Short term trend of population size within the network; Method used	The data underpinning the assessment of short-term trend is of mixed quality and this is reflected in the overall assessment of method type. Trend data for the sporophyte is derived from reasonably regular and comprehensive surveys by NRW staff and local botanists. Limited information is available on which to judge any trend in the gametophyte and for this life stage the trend assessment is made largely on the strength of expert Judgement.