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

Conservation status assessment for the species:

S1386 - Green shield-moss (*Buxbaumia viridis*)

UNITED KINGDOM

IMPORTANT NOTE - PLEASE READ

- The information in this document represents 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.
- It is based on supporting information provided by the geographically-relevant Statutory Nature Conservation Bodies, which is documented separately.
- The 2019 Article 17 UK Approach document provides details on how this supporting information contributed to the UK Report and the fields that were completed for each parameter.
- The reporting fields and options used are aligned to those set out in the European Commission guidance.
- Maps showing the distribution and range of the species are included (where available).
- Explanatory notes (where provided) are included at the end. These provide additional audit trail information to that included within the UK assessments. Further underpinning explanatory notes are available in the related country-level reports.
- 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; and/or (iii) the field was not relevant to this species (section 12 Natura 2000 coverage for Annex II species).
- The UK-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.

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NATIONAL LEVEL

1. General information

1.1 Member State	**UK**
1.2 Species code	**1386**
1.3 Species scientific name	**Buxbaumia viridis**
1.4 Alternative species scientific name	
1.5 Common name (in national language)	Green shield-moss

2. Maps

2.1 Sensitive species	No
2.2 Year or period	1999-2017
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

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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

Rao, S. 2017. National Trust for Scotland survey data for 2017 - unpublished
British Bryological Society. 2018. Database to the end of 2017 (available via the NBN)
Genney, D.R. and McSorley, C.A. In prep. Exploring the range limits of the scarce moss Buxbaumia viridis in Scotland.
Agnew, J. and Rao, S. 2016. Buxbaumia viridis hot-spot survives severe flooding. Field Bryology.115. pp. 19-21.
Taylor, S. 2012. Records of Buxbaumia viridis growing on new substrates. Field Bryology.107. pp. 21-22.
Taylor, S. 2010. Buxbaumia viridis in Abernethy Forest and other sites in northern Scotland. Field Bryology.100. pp. 9-14.
Rothero, G.P. 2007. Survey of suitable habitats for Green Shield-moss Buxbaumia viridis on Deeside and Donside. Scottish Natural Heritage Commissioned Report.279.
Rothero, G. P. Genney, D. R., Taylor, S. 2013 - 2016. Surveillance of priority bryophytes in Scotland: Buxbaumia viridis. Unpublished report to SNH.
Thompson, R. 2017. Forest Enterprise Scotland survey data for 2017 - unpublished
Taylor, S. 2017. survey data to the end of 2017 - unpublished where not yet submitted to the NBN.

5. Range

5.1 Surface area (km²)

12248

5.2 Short-term trend Period

2013-2018

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5.3 Short-term trend Direction	Uncertain (u)	
5.4 Short-term trend Magnitude	a) Minimum	b) Maximum
5.5 Short-term trend Method used	Based mainly on extrapolation from a limited amount of data	
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)	6127
	b) Operator	
	c) Unknown	
	d) Method	The FRR is the same as in 2013. The value is considered to be large enough to support a viable population and no lower than the range estimate when the Habitats Directive came into force in the UK. For further information see the 2019 Article 17 UK Approach document.
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	New surveys during 2015/16 and 2016/17 were carried out to gain a better understanding of the species' UK range. Success of these surveys has greatly expanded understanding of the species range in the UK. There is no reason to suspect the species has expanded it's range, but understanding of its range has improved. The current range surface area is above the FRR.	

6. Population

6.1 Year or period	1999-2017	
6.2 Population size (in reporting unit)	a) Unit	number of map 1x1 km grid cells (grids1x1)
	b) Minimum	88
	c) Maximum	91
	d) Best single value	89
6.3 Type of estimate	Best estimate	
6.4 Additional population size (using population unit other than reporting unit)	a) Unit	number of individuals (i)
	b) Minimum	3583
	c) Maximum	3639
	d) Best single value	3639
6.5 Type of estimate	Best estimate	
6.6 Population size Method used	Based mainly on extrapolation from a limited amount of data	
6.7 Short-term trend Period	2007-2017	
6.8 Short-term trend Direction	Uncertain (u)	

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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	1167 with unit number of individuals (i) The FRP is the same as in 2013. The FRP value is in number of individuals and is the estimated population size in 2013. The value is considered to be large enough to support a viable population and no less than when the Habitats Directive came into force in the UK. For further information see the 2019 Article 17 UK Approach document.
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	The best estimate of occupied 1x1 km squares is slightly higher than the minimum value. The current recorded population is higher than the FRP.	

7. Habitat for the species

7.1 Sufficiency of area and quality of occupied habitat	a) Are area and quality of occupied habitat sufficient (for long-term survival)? b) Is there a sufficiently large area of unoccupied habitat of suitable quality (for long-term survival)?	Yes
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	Unknown (x)	
7.5 Short-term trend Method used	Insufficient or no data available	
7.6 Long-term trend Period		
7.7 Long-term trend Direction		
7.8 Long-term trend Method used		
7.9 Additional information		

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8. Main pressures and threats

8.1 Characterisation of pressures/threats

Pressure	Ranking
Interspecific relations (competition, predation, parasitism, pathogens) (L06)	M

Threat	Ranking
Removal of dead and dying trees, including debris (B07)	M
Clear-cutting, removal of all trees (B09)	M
Forest management reducing old growth forests (B15)	M
Conversion from other land uses to housing, settlement or recreational areas (excluding drainage and modification of coastline, estuary and coastal conditions) (F01)	M
Conversion from other land uses to commercial / industrial areas (excluding drainage and modification of coastline, estuary and coastal conditions) (F03)	M
Other invasive alien species (other then species of Union concern) (I02)	M
Interspecific relations (competition, predation, parasitism, pathogens) (L06)	M
Increases or changes in precipitation due to climate change (N03)	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 and taken

9.2 Main purpose of the measures taken

Maintain the current range, population and/or habitat for the species

9.3 Location of the measures taken

Both inside and outside Natura 2000

9.4 Response to the measures

Medium-term results (within the next two reporting periods, 2019-2030)

9.5 List of main conservation measures

Adapt/change forest management and exploitation practices (CB05)

Stop forest management and exploitation practices (CB06)

Manage conversion of land for construction and development of infrastructure (CF01)

9.6 Additional information

10. Future prospects

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10.1 Future prospects of parameters	a) Range	Good
	b) Population	Good
	c) Habitat of the species	Good
10.2 Additional information	Future trend of Range is Overall stable; Future trend of Population is Overall stable; and Future trend of Habitat for the species is Overall stable. There are no high level pressures affecting this species. Conservation measures are in place, which are expected to act in the medium term. For further information on how future trends inform the Future Prospects conclusion see the 2019 Article 17 UK Approach document.	

11. Conclusions

11.1. Range	Favourable (FV)
11.2. Population	Favourable (FV)
11.3. Habitat for the species	Favourable (FV)
11.4. Future prospects	Favourable (FV)
11.5 Overall assessment of Conservation Status	Favourable (FV)
11.6 Overall trend in Conservation Status	Unknown (x)
11.7 Change and reasons for change in conservation status and conservation status trend	a) Overall assessment of conservation status Improved knowledge/more accurate data The change is mainly due to: Improved knowledge/more accurate data b) Overall trend in conservation status No change The change is mainly due to:
11.8 Additional information	Conclusion on Range reached because: (i) the short-term trend direction in Range surface area is unknown; and (ii) the current Range surface area is not less than the Favourable Reference Range. Conclusion on Population reached because: (i) the short-term trend direction in Population size is unknown; and (ii) the current Population size is not less than the Favourable Reference Population. Conclusion on Habitat for the species reached because: (i) the area of occupied and unoccupied habitat is sufficiently large for the long-term survival of the species; and (iii) the short-term trend in area of habitat is unknown. Conclusion on Future prospects reached because: (i) the Future prospects for Range are good; (ii) the Future prospects for Population are good; and (iii) the Future prospects for Habitat for the species are good. Overall assessment of Conservation Status is Favourable because all of the conclusions are Favourable. Overall trend in conservation status is unknown.

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Overall Conservation Status has changed from Unknown in 2013 to Favourable because, Population, Habitat for the species and Future Prospects have all changed from Unknown to Favourable.

Overall trend in Conservation Status has not changed since 2013.

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 map 1x1 km grid cells (grids1x1)
	b) Minimum	
	c) Maximum	
	d) Best single value	57
12.2 Type of estimate		Minimum
12.3 Population size inside the network Method used		Based mainly on extrapolation from a limited amount of data
12.4 Short-term trend of population size within the network Direction		Uncertain (u)
12.5 Short-term trend of population size within the network Method used		Insufficient or no data available
12.6 Additional information		This assessment is based on the number of 1x1km squares that overlap with Natura sites. It may be that an exact location was just outside a site boundary. However, the population unit is a 1x1km grid square and since this is a reasonable scale at which to assess populations of this moss, it is appropriate to allocate any overlapping 1x1km grids with a Natura site to that site. No attempt is made here to comment on trend because there has been no systematic survey within Natura sites, but rather a more extensive and targeted surveying of new locations, including previously unexplored Natura sites.

13. Complementary information

13.1 Justification of % thresholds for trends	
13.2 Trans-boundary assessment	
13.3 Other relevant Information	New survey information has increased the knowledge of the range and population size for this species and this has resulted in a change in conservation status assessment from Unknown in 2013 to Favourable.

Distribution Map

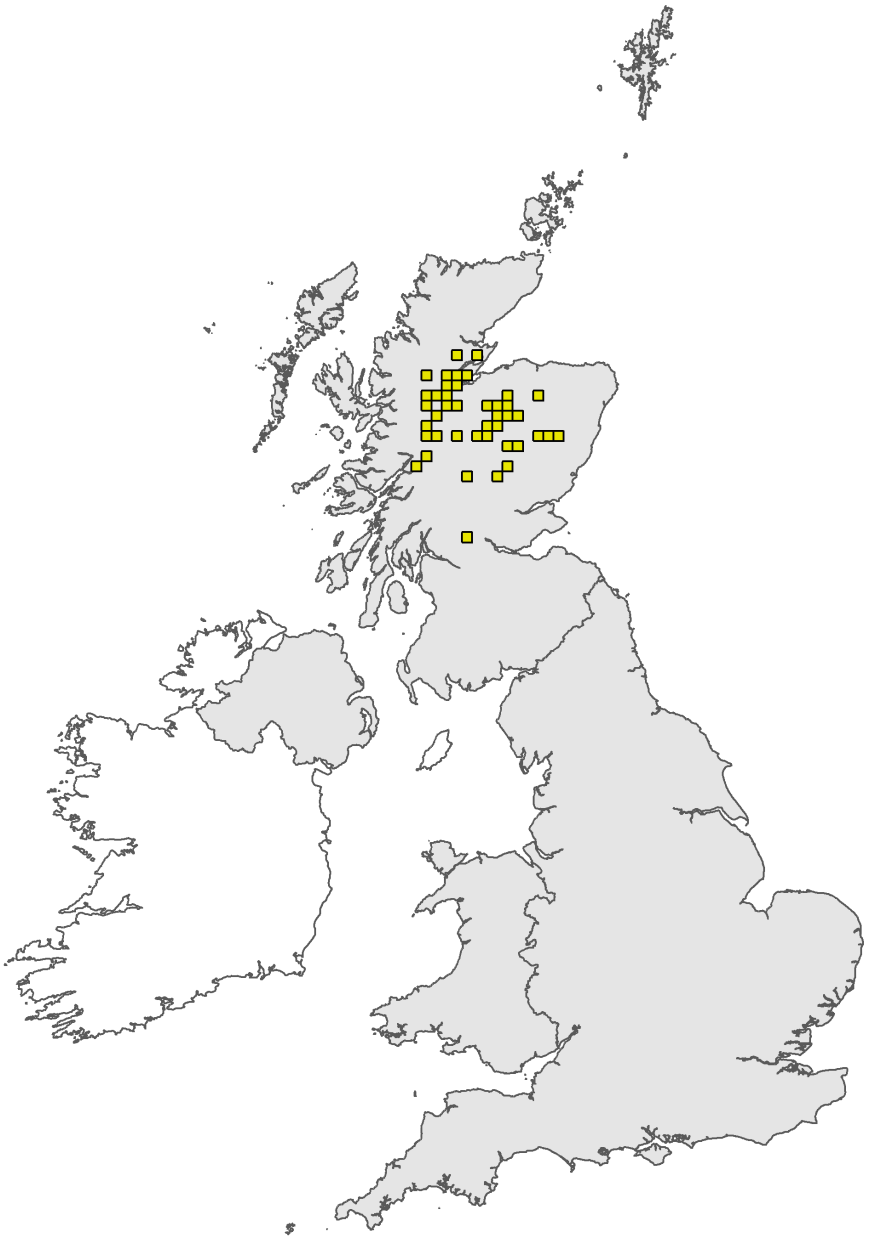

Figure 1: UK distribution map for S1386 - Green shield-moss (*Buxbaumia viridis*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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 S1386 - Green shield-moss (*Buxbaumia viridis*). 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: Buxbaumia viridis (1386) Region code: ATL

Field label	Note
5.3 Short term trend; Direction	While the data show a large increase in the range of this moss, this is almost certainly due to more extensive and targeted survey effort. The short-term range trend is reported as uncertain however because while we assume range has remained stable we do not know how recently populations in mature conifer plantations have established and these sites have a significant impact on range.
5.11 Change and reason for change in surface area of range	SNH commissioned surveys during the winters of 15/16 and 16/17 focussed on known habitat characteristics outwith the then known range of this moss. Areas to the north, west and south were targeted specifically to gain a better understanding of the species' UK range. Potential habitat included native woodland and old Norway spruce plantations. Success through these surveys, and additional surveillance by volunteers (BBS) has greatly expanded our understanding of the moss's range. Since this is the first time this species has been searched for in these areas, and there was adequate suitable habitat, there is no reason to suspect the species has expanded it's range, rather our understanding of its range has improved. The moss is, however, clearly less frequent outwith its core Speyside range with c. 29 km of survey path recorded for each new record.
6.2 Population size	The maximum number of occupied 1-km squares is a non-conservative estimate based on the assumption that at this scale the moss has the potential to be present in all squares in which it has been recorded since 2009. The minimum estimate assumes that the moss has been lost from 1-km squares in which it has not been recorded in the past two reporting periods, i.e. since the end of 2006. The best estimate is a slightly higher than the minimum value which assumes the species has been lost from just two sites that have been intensively surveyed without success.
6.4 Additional population size	The number of capsules is included as an alternative unit because this was used for the 2013 report. Capsules are, however, not necessarily related to the number of individuals because an individual may produce multiple capsules. In addition, because the non-reproductive plant is cryptic, we do not know the distribution of non-fertile plants. However, based on capsules the maximum number of capsules is based on the sum of all capsules recorded since 2002. It assumes that each capsule is recorded once and that each year represents a new capsule. This may not be the case, e.g. when one surveyor visits a location in early winter and another visits the same location in later winter of the same season. (this scenario is not likely). The minimum value excludes capsules recorded pre-2007. Note that capsule number is not available for a small number of records. In such cases a single capsule is assumed.
6.6 Population size; Method used	Given the inability to survey all of the species' range within each reporting period the survey cannot be said to be complete. The UK guidance says to record '(d) insufficient or no data available' if the reported population is less than 75% of the presumed actual population'. This is most likely the case for this species given the large areas on unexplored potential habitat.
6.8 Short term trend; Direction	The data shows an increase in 1-km square records over the short-term period. However, this is almost certainly due to more extensive and targeted survey effort so the actual trend is uncertain. Uncertain rather than unknown because we have no reason to believe there has been a significant change over this period. Change could have occurred however because it is not known how recently populations in mature conifer plantations have established and these sites could have had a significant impact on population as measured by 1-km squares.

6.9 Short term trend; Magnitude	Magnitude calculated by dividing the number of occupied 1-km squares between 2013-2017 (58) by the number of 1-km squares occupied between 2007-2012 (44).
6.10 Short term trend; Method used	Given the inability to survey all of the species' range within each reporting period the survey cannot be said to be complete. The UK guidance says to record '(d) insufficient or no data available' if the reported population is less than 75% of the presumed actual population'. This is most likely the case for this species given the large areas on unexplored potential habitat.
6.12 Long term trend; Direction	The data shows an increase in 1-km square records over the short-term period. However, this is almost certainly due to more extensive and targeted survey effort so the actual trend is uncertain. Uncertain rather than unknown because we have no reason to believe there has been a significant change over this period. Change could have occurred however because it is not known how recently populations in mature conifer plantations have established and these sites could have had a significant impact on population as measured by 1-km squares.
6.13 Long term trend; Magnitude	Magnitude calculated by dividing the number of occupied 1-km squares between 2007-2017 (87) by the number of 1-km squares occupied between 1995-2006 (10).
6.15 Favourable reference population	FRP is based on individual capsules because this was the unit used in the 2013 report.
7.2 Sufficiency of area and quality of occupied habitat; Method used	When this moss was added to the directive it was thought to be a species primarily restricted to large diameter pine deadwood in humid locations. It is now known to occur on a much wider range of substrates (including needle litter, ant hills, bracket fungi, hardwoods and softwoods), on smaller diameter deadwood, and in slightly more exposed situations (found above head-level in living trees at some locations). Perhaps of greatest significance the moss is frequently found on Norway spruce deadwood and roots in older plantations. As such the range of suitable habitat is too wide to quantify with any accuracy. Surveyors commissioned by SNH to search unexplored potential habitat outwith the known range walked over 600-km per season in search for the moss. All surveyors reported that the amount of potential habitat far exceeded the amount of occupied habitat.
8.1 Characterisation of pressures/ threats	While a number of potential threats have been identified, only one pressure is reported here, L06. While some of the threats have likely operated as local pressures between 2013 and 2018, there is no evidence that these have had a national long-term impact on the viability of the moss. The previous A17 report identified 'Forest and Plantation management & use' at a pressure. However, we are not aware of any losses due to forestry operations in this period. There may have been losses that we didn't know about, but these are best represented by assigning as a future threat rather than a pressure. The previous A17 report highlighted loss or lack of habitat as the primary threat. This still holds true and is reflected in the selection of threats that impact on habitat continuity or loss of woodland habitat. All have been given 'Medium' importance with respects to the overall likely impact on long-term viability on the basis that the moss is either located within protected sites or widely enough distributed not to be adversely impacted by local pressures. A more specific suite of forestry threats has been selected to acknowledge the increase in records from commercial plantations i.e. not all commercial forest management is a threat. Hydro development has been identified as a potential threat because it may impact on suitable habitat in the western extent of the plant's distribution i.e. due to track and pipeline installation. One climate change threat has been included to recognise that the moss requires humid conditions. The impact of drier weather is unknown at present but a potential threat. Existing populations are most likely to be lost due to natural succession and replacement by larger mosses, lichens and vascular plants.

9.5 List of main conservation measures	A number of measures have been put in place to maintain or enhance habitat for Buxbaumia viridis including: 1) RSPB Abernethy continue to implement a long-term deadwood management plan within Cairngorms SAC. 2) Following discovery of a large source population of Buxbaumia viridis on Norway Spruce plough lines in SNH's Dell Wood NNR, the trees will be retained rather than removed as non-native species. This will provide a good source of spores to promote establishment of the moss in adjacent suitable native habitat. 3) All Forest Enterprise Scotland (FES) environment staff have been trained to identify and manage important deadwood resources. This includes maximising deadwood creation opportunities within cyclical clear-fell sites. 4) FES and SNH have developed a protocol to aid management and licensing decisions on the National Forest Estate. This helps foresters identify known and potential locations for the moss, avoid where possible and provide landscape-scale management compensation, such as creation of forest reserves, where impact is unavoidable.
10.1 Future prospects of parameters	While we have reported the trend in range as 'uncertain' we are confident that, given the extent of apparently suitable habitat, the future prospects for range are good. This is, however, based on expert opinion rather than evidence. Similarly we consider the overall prospects for population to be stable and favourable based on expert opinion. A number of threats have been identified but given the extent of apparently suitable habitat, well beyond the current FRR, and good management and protection of the core area for this species, we think that 'good' is a more useful conclusion than 'Unknown'. Again, we have had to say that the trend in habitat for the species is unknown/uncertain, but as described in 7.2 audit notes, the current breadth of habitat is much wider than understood at the time this species was added to the directive. Added to the fact that surveyors reports large areas of potential habitat through their extensive survey, we feel, on balance, it more appropriate to report that the future prospects for habitat are good.
11.1 Range	We do not have enough certainty about the trend in range so, despite the current range currently being much larger than the FRR, we must conclude 'Inadequate' for this parameter. It is likely to be 'Favourable' however if based on expert opinion.
11.2 Population	Because the population is not lower than 'favourable reference population we conclude this is favourable.
11.3 Habitat for the species	We do not have enough certainty about the trend in habitat for the species so, despite our opinion that there is far more suitable habitat than required to maintain the FRP we must conclude 'Inadequate' for this parameter. It is likely to be 'Favourable' however if based on expert opinion.
11.4 Future prospects	While we have identified a number of potential threats, on balance we don't consider these significant enough (based on current evidence) to have an impact on the long-term viability of the species.
12.1 Population size inside the pSCIs, SCIs and SACs network	Use the 90 x 1-km squares used for the best estimate (all squares except Kindrogan).