

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

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:

S2494 - Whitefish (*Coregonus lavaretus*)

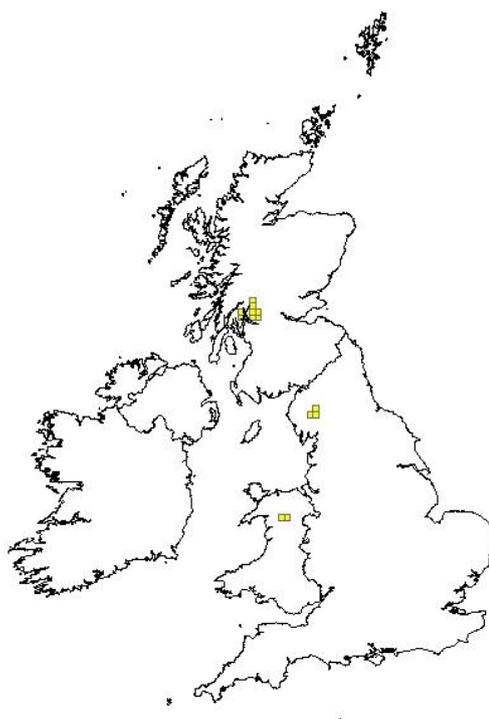
IMPORTANT NOTE – PLEASE READ

- The country-level reporting information contained in this document is a contribution to the Article 17 UK report for the habitat/species concerned.
- It has been provided by **Scottish Natural Heritage** and refers only to the state of the habitat/species in **Scotland** - it does not constitute an assessment for the whole of the UK.
- The Article 17 UK Approach document provides details on how this information has been used and, combined with information supplied by other Statutory Nature Conservation Bodies
- The format of the document is closely aligned to that set out by the European Commission for Member State reporting – as a result, some of the fields are not applicable at a country-level and have deliberately been left blank – in addition, the content of most fields is constrained by the EC reporting categories.

Reporting format on the 'main results of the surveillance under Article 11' for Annex II, IV & V species

<i>Field name</i>	<i>Brief explanations</i>	
0.2 Species	0.2.1 Species code	S2494
	0.2.2 Species scientific name	<i>Coregonus lavaretus</i>
	0.2.3 Alternative species scientific name Optional	
	0.2.4 Common name Optional	Vendace

1.1 Maps		
1.1.1 Distribution map		Sensitive False
	<p>Native populations only known from two waterbodies in Scotland – Lochs Eck and Lomond.</p> <p>NBN data more recent from 1995 do not include Loch Eck.</p> <p>Locations where the species has been translocated have not been included. Commission guidance states that: "....However, individuals or feral populations of an animal species introduced on purpose or accidentally by man to places where they have not occurred naturally in historical times or where they would not have spread to naturally in foreseeable future, should be considered as being outside their natural range and consequently not covered by the Directive." Using this definition, then the translocated populations should not form part of the assessment.</p>	



1.1.2 Method used - map	Estimate based on partial data with some extrapolation and/or modelling Data provided as individuals/ha-1 . data extrapolated to cover the whole waterbody area, however this is likely to lead to an overestimate of abundance as the sampling method is only effective in waters >5 m depth. Including shallower areas which are unlikely to host <i>C. lavaretus</i> will lead to an overestimate of fish abundance. MAITLAND, P.S. 2007 Scotland's Freshwater Fish: Ecology, Conservation & Folklore. Trafford Publishing, Oxford. ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009
1.1.3 Year or period	1995-2012
1.1.4 Additional distribution map	False
1.1.5 Range map	

2.1 Biogeographical region & marine regions	ATL
2.2 Published sources	<p>"DAVIES, CE, SHELLEY, J, HARDING, PT, MCLEAN, IFG, GARDINER, R & PEIRSON, G (eds.) 2004. Freshwater fishes in Britain. The species and their distribution. Colchester: Harley Books</p> <p>MAITLAND, P.S. 1994. Fish. In: The Fresh Waters of Scotland: A National resource of International Significance. (eds. P.S. Maitland, P.J. Boon & D.S. McLusky),. pp.191-208. Wiley & Sons Publ. Ltd. 639pp.</p> <p>MAITLAND, P.S. 2004 Keys to the Freshwater Fish of Britain and Ireland with notes on their distribution and ecology . Freshwater Biological Association , Scientific Publication No. 62, 245pp.</p> <p>MAITLAND P.S. & LYLE, A.A. 1990. Practical conservation of British fishes: current action on six declining species. Journal of Fish Biology (Suppl. A) 1, 25-54.</p> <p>WINFIELD, I.J., FLETCHER, J.M. & CRAGG-HINE, D. 1994. Status of Rare Fish: A Literature Review of Freshwater Fish in the UK. National Rivers Authority R&D Report No. 18, 58pp.</p> <p>WINFIELD, I. J., ADAMS, C. E. & FLETCHER, J. M. 1996. Recent introductions of the ruffe (<i>Gymnocephalus cernuus</i>) to three United Kingdom lakes containing <i>Coregonus</i> species. Annales Zoologici Fennici 33, 459-466.</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in Loch Eck. Final Report. Report to Scottish Natural Heritage. LA/C02852/1. 22 pp.</p>

WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in standing waters (Phase II). Final Report. Report to Scottish Natural Heritage. LA/C02256/4. 40 pp.

WINFIELD, I. J., FLETCHER, J. M., JAMES, J. B., BEAN, C. W. & DUIGAN, C. (submitted). Setting reference values for lake fish abundance: observations from unexploited or lightly exploited vendace (*Coregonus albula*), whitefish (*C. lavaretus*) and Arctic charr (*Salvelinus alpinus*) populations in the U.K. In: Cowx, I. G. (editor) *Assessing the Ecological Status of Rivers, Lakes and Transitional Waters*. Oxford: Fishing News Books, Blackwell Scientific Publications,

WINFIELD, I.J., FLETCHER, J.M., JAMES, B.J., DUIGAN, C.A., BEAN, C.W., & N.C. DURIE (2007) Long-term case histories of ruffe (*Gymnocephalus cernuus*) introductions to four U.K. lakes containing native vendace (*Coregonus albula*) or whitefish (*C. lavaretus*) populations. *Advances in Limnology* 60, 301-309.

WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611

ETHERIDGE, E. Aspects of the conservation biology of *Coregonus lavaretus* in Britain. Unpublished PhD Thesis, University of Glasgow 2009

ETHERIDGE, E. C., BEAN, C.W., MAITLAND P. S. & ADAMS C. E. (2010) Morphological and ecological responses to a conservation translocation of powan (*Coregonus lavaretus*) in Scotland. *Aquatic Conservation: Marine & Freshwater Ecosystems* 20, 274-281.

ETHERIDGE, E.C., HARROD, C., BEAN, C.W. & ADAMS, C.E. (2010) Has habitat heterogeneity promoted phenotypic and ecological sub-structuring among a *Coregonus lavaretus* population in a large Scottish lake? *J. Fish Biol.* 77, 2391-2404.

ETHERIDGE, E.C., BEAN, C.W. & ADAMS, C.E. (2011) Substrate specific vulnerability of Scottish powan (*Coregonus lavaretus*) ova to predation by invasive ruffe (*Gymnocephalus cernuus*). *Ecology of Freshwater Fish* 20, 299-307.

ETHERIDGE, E.C., ADAMS, C.E., BEAN, C.W., DURIE, N. C., GOWANS, A. R. HARROD, C., LYLE, A.A., MAITLAND, P.S. & WINFIELD, I.J. (2012) Are phenotypic traits useful for differentiating among a priori *Coregonus* taxa?. *Journal of Fish Biology* 80, 387-407."

DAVIES, CE, SHELLY, J, HARDING, PT, MCLEAN, IFG, GARDINER, R & PEIRSON, G (eds.) 2004. *Freshwater fishes in Britain. The species and their distribution*. Colchester: Harley Books

- MAITLAND, P.S. 1994. Fish. In: The Fresh Waters of Scotland: A National resource of International Significance. (eds. P.S. Maitland, P.J. Boon & D.S. McLusky),. pp.191-208. Wiley & Sons Publ. Ltd. 639pp.
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- WINFIELD, I. J., ADAMS, C. E. & FLETCHER, J. M. 1996. Recent introductions of the ruffe (*Gymnocephalus cernuus*) to three United Kingdom lakes containing *Coregonus* species. *Annales Zoologici Fennici* 33, 459-466.
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	<p>ETHERIDGE, E.C., HARROD, C., BEAN, C.W. & ADAMS, C.E. (2010) Has habitat heterogeneity promoted phenotypic and ecological sub-structuring among a <i>Coregonus lavaretus</i> population in a large Scottish lake? <i>J. Fish Biol.</i> 77, 2391-2404.</p> <p>ETHERIDGE, E.C., BEAN, C.W. & ADAMS, C.E. (2011) Substrate specific vulnerability of Scottish powan (<i>Coregonus lavaretus</i>) ova to predation by invasive ruffe (<i>Gymnocephalus cernuus</i>). <i>Ecology of Freshwater Fish</i> 20, 299-307.</p> <p>ETHERIDGE, E.C., ADAMS, C.E., BEAN, C.W., DURIE, N. C., GOWANS, A. R. HARROD, C., LYLE, A.A., MAITLAND, P.S. & WINFIELD, I.J. (2012) Are phenotypic traits useful for differentiating among a priori <i>Coregonus</i> taxa?. <i>Journal of Fish Biology</i> 80, 387-407.</p>
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2.3 Range			
2.3.1 Surface area Range	75.7		
2.3.2 Method used Surface area of Range	<p>Estimate based on partial data with some extrapolation and/or modelling</p> <p>Two sites, Loch Eck (4.6 km²) and Loch Lomond (71.1 km²) are the only two sites in Scotland where this species is naturally extant. Range does NOT include translocated populations at Loch Sloy or Carron Valley Reservoir.</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>Total surface area of Loch Eck and Lomond combined are 75.7 km²</p> <p>Alpha value?</p> <p>Surface area measured directly from OS maps –high quality data.</p> <p>No caveats</p> <p>Range does NOT include translocated populations at Loch Sloy or Carron Valley Reservoir.</p>		
2.3.3 Short-term trend Period	<p>2004-2008</p> <p>Data only available from 2004/5-2007/8 (two SCM cycles)</p>		
2.3.4 Short term trend Trend direction	<p>stable</p> <p>If site number and range is the relevant parameter here, then this is clearly a '0'. No sites have been lost and natural expansion is not an option</p>		
2.3.5 Short-term trend Magnitude	<table border="1" style="width: 100%;"> <tr> <td style="width: 60%;">a) Minimum</td> <td style="text-align: center;">0</td> </tr> </table> <p>0% change (2 Sites covering 75.7 km²)</p> <p>No change from 2007</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>There has been no loss of sites within Scotland – this species is still present within Lochs Eck and Lomond. 0% change and 0% magnitude. No trend evident.</p> <p>Confirmation by sampling sites during SCM and Etheridge PhD.</p> <p>Data high quality.</p> <p>No caveats or issues.</p>	a) Minimum	0
a) Minimum	0		

	b) Maximum	0
2.3.6 Long-term trend Period	2004-2008	
	No sites lost and situation has been the same since records began in 1883 MAITLAND, P.S. 2007 Scotland's Freshwater Fish: Ecology, Conservation & Folklore. Trafford Publishing, Oxford.	
2.3.7 Long-term trend Trend direction	stable	
2.3.8 Long-term trend Magnitude	a) Minimum	0
Optional	<p>Only recorded from two waterbodies in Scotland – Lochs Eck (NS138921) and Lomond (NS354978). These species are still present there and the long-term range is stable. DAVIES, CE, SHELLEY, J, HARDING, PT, MCLEAN, IFG, GARDINER, R & PEIRSON, G (eds.) 2004. Freshwater fishes in Britain. The species and their distribution. Colchester: Harley Books</p> <p>MAITLAND, P.S. 2004 Keys to the Freshwater Fish of Britain and Ireland with notes on their distribution and ecology . Freshwater Biological Association , Scientific Publication No. 62, 245pp.</p> <p>MAITLAND, P.S. 2007 Scotland's Freshwater Fish: Ecology, Conservation & Folklore. Trafford Publishing, Oxford.</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>There has been no loss of sites within Scotland – this species is still present within Lochs Eck and Lomond. 0% change and 0% magnitude. No trend evident. Confirmation by sampling sites during SCM and Etheridge PhD. Data high quality. No caveats or issues.</p>	
	b) Maximum	0
2.3.9 Favourable reference range	a) Value in km²	75.7
	<p>Only recorded from two waterbodies in Scotland – Lochs Eck (NS138921) and Lomond (NS354978). Both populations are still extant. Range excludes two translocated populations in Loch Eck and Carron Valley Reservoir. DAVIES, CE, SHELLEY, J, HARDING, PT, MCLEAN, IFG, GARDINER, R & PEIRSON, G (eds.) 2004. Freshwater fishes in Britain. The species and their distribution. Colchester: Harley Books</p> <p>MAITLAND, P.S. 2004 Keys to the Freshwater Fish of Britain and Ireland</p>	

	with notes on their distribution and ecology . Freshwater Biological Association , Scientific Publication No. 62, 245pp.	
	MAITLAND, P.S. 2007 Scotland's Freshwater Fish: Ecology, Conservation & Folklore. Trafford Publishing, Oxford.	
	ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009	
	Range is stable – rationale behind this is based on the fact that <i>C. lavaretus</i> have only been recorded from two waterbodies in Scotland and recent survey work (i.e SCM) and research work (i.e. Etheridge's PhD) have confirmed that they are still present.	
	No caveats or other issues.	
	b) Operator for FRR	
	c) FRR is unknown (indicated by "true")	False
	d) Method used to set FRR	
2.3.10 Reason for change Is the difference between the reported value in 2.3.1 and the previous reporting round mainly due to...	a) Genuine change?	False
	no change	
	b) Improved knowledge/more accurate data?	False
	Existing data is very accurate No change in range, data obtained from recent survey and research outlined above	
	c) Use of different method (e.g. "Range tool")?	False

2.4 Population		
2.4.1 Population size estimation (using individuals or agreed exceptions where possible)	a) Unit	number of individuals
	Data is given for the number of individuals per site and as a Scottish total (but see commentary in 2.4.2).	
	106, 592 individuals (geometric mean of data collected 2007/8)	
	b) Minimum	68892
	68,892 (2007/8 data)	

	c) Maximum	170526
	170,526 (2007/8 data)	
2.4.2 Population size estimation (using population unit other than individuals) Optional (<i>if 2.4.1 filled in</i>)	a) Unit	number of localities
	Number of sites where the species is native	
	b) Minimum	2
	c) Maximum	2
2.4.3 Additional information on population estimates / conversion Optional	a) Definition of "locality"	Locality is the site in which the species is present. There are two localities where <i>C. lavaretus</i> are naturally extant. Population (individuals) data is available for both but added together here to give a Scotland-wide figure.
	Locality is the site in which the species is present. There are two localities where <i>C. lavaretus</i> are naturally extant. Population (individuals) data is available for both but added together here to give a Scotland-wide figure.	
	b) Method to convert data	
	Data from SCM is provided as the geometric mean value for the number of individuals per hectare. 95% confidence limits for that figure are also presented. This is the standard method for reporting data for fish populations when it is gathered using hydroacoustic methods. Here, we have extrapolated the mean value (and the 95% confidence limits) to cover the entire surface area of each waterbody.	
	c) Problems encountered to provide population size estimation	
	This may lead to an overestimate of fish abundance because this survey technique is only effective in water depths >5 m and does not cover shallower littoral areas. The simplest and most truthful estimate of abundance should be the number of naturally occupied waterbodies. Coregonids (such as <i>C. lavaretus</i>) exhibit highly variable inter-annual recruitment pattern and one-off surveys may give an entirely wrong impression re actual population size (as the absolute number of individuals)	
2.4.4 Year or period	2004-2008	
2.4.5 Method used Population size	Estimate based on partial data with some extrapolation and/or modelling	
	WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611 Geometric mean 106,592 (95% CL lower 68,892 – 95% CL upper 170,526) Number of individuals (data available for each site but presented as Scottish total). It was a Conservation Agency decision to present data	

	<p>as number of individuals. SNH has reservations about this approach (and false accuracy) and these are stated in section 2.4.3.</p> <p>Data was collected via the use of a specialised protocol which centres on data collected by Nordic gillnetting and hydroacoustics – a methodology developed by SNH and now used widely outwith Scotland. It is reliable data but relies on data being collected at regular intervals.</p>	
2.4.6 Short-term trend Period	2004-2008	
	<p>Recruitment within this taxa shows high inter-annual variability and to gain an accurate picture it is important to sample more frequently than a six-yearly cycle. Data gathered for Loch Eck during 2004/5 and 2007 would suggest a slight increase (62,468 to 93,795). Similar data for Loch Lomond would suggest the opposite (44,793 (2004)-12,798 (2007)). For Scotland as a whole, the numbers remain relatively stable (107,261 (2004/5) to 106,592 (2007)).</p> <p>These data exemplify why more than two data points are required to determine trends even over the short-term.</p>	
2.4.7 Short-term trend Trend direction	stable	
	<p>The short-term trend information must be viewed with extreme caution – for the reasons given in 2.4.6.</p> <p>Using data for the whole of Scotland one would have to conclude that the trend direction is slightly < For Loch Eck it is significantly >, and for Loch Lomond it is significantly <.</p>	
2.4.8 Short-term trend Magnitude	a) Minimum	
	Large inter-annual variations in recruitment and two data points makes this impossible to determine.	
	b) Maximum	
	Large inter-annual variations in recruitment and two data points makes this impossible to determine.	
	c) Confidence interval	
	95% CL around the geometric mean are given for each of the population assessments given. It is not possible however to provide a confidence level for the percentage magnitude of change with so few data.	
2.4.9 Short-term trend Method used	Estimate based on partial data with some extrapolation and/or modelling	
	<p>Stable across Scotland, but data resolution not good enough to determine short term declines within populations. L. Eck is considered to be stable, L. Lomond may be experiencing some decline due to the presence of ruffe</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in Loch Eck. Final Report. Report to Scottish Natural Heritage. LA/C02852/1. 22 pp.</p>	

	<p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in standing waters (Phase II). Final Report. Report to Scottish Natural Heritage. LA/C02256/4. 40 pp.</p> <p>WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>Stable 2004/5 – 2007/8 Nordic gillnets and hydroacoustics – high quality data for the years in which data has been collected. Only two data points available per location making trend description difficult. This is too coarse an assessment to pick up short term declines in Loch Lomond due to the presence of ruffe</p>	
2.4.10 Long-term trend – Period	2004-2008	
	Assumed stable, though quantitative data before 2004/5 using the standard methodology not available	
2.4.11 Long-term trend Trend direction	stable	
2.4.12 Long-term trend Magnitude Optional	a) Minimum	
	Not possible to calculate with data available	
	b) Maximum	
	c) Confidence interval	
2.4.13 Long term trend Method used	2	
	<p>See comments above re the lack of 'long-term' data. Population data over the suggested 24-year timeframe is not available for this species</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in Loch Eck. Final Report. Report to Scottish Natural Heritage. LA/C02852/1. 22 pp.</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in standing waters (Phase II). Final Report. Report to Scottish Natural Heritage. LA/C02256/4. 40 pp.</p> <p>WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition</p>	

	<p>Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>Trend stable – for number of sites</p> <p>Trend stable for Loch Eck- the site is in favourable condition. Trend is thought to be a decline in Loch Lomond, where the presence of ruffe is thought to be contributing to a long-term decline.</p> <p>There is some historical information available about the relative abundances of various fish in Loch Lomond, however, Loch Eck is less well studied and little information is available. It is apparent that there have been extensive changes in the Loch Lomond fish community over time due to a series of fish introductions (see Etheridge & Adams 2008). In the past powan was the most numerous fish in Loch Lomond (Slack et al, 1957) – though these data do not include a comparable population estimate that can be used in this report. More recently, the Loch Lomond fish community is dominated by ruffe (Winfield et al. 1996; Etheridge et al. 2011).</p> <p>In Loch Eck there is no evidence of a decline in powan, but there appears to be a decline of Arctic charr (<i>Salvelinus alpinus</i>) (Winfield et al., 2009).</p> <p>ETHERIDGE E. C. & ADAMS C. E. (2008) Bream (<i>Abramis brama</i>), a new fish species confirmed in Loch Lomond, <i>Glasgow Naturalist</i>, 25: 93-94.</p> <p>ETHERIDGE, E.C., BEAN, C.W. & ADAMS, C.E. (2011) Substrate specific vulnerability of Scottish powan (<i>Coregonus lavaretus</i>) ova to predation by invasive ruffe (<i>Gymnocephalus cernuus</i>). <i>Ecology of Freshwater Fish</i> 20, 299-307.</p> <p>SLACK H. D., GERVERS F. W., & HAMILTON J. D. (1957) The biology of the powan. In: <i>Studies on Loch Lomond I</i> (ed H. D. Slack) pp. 113-127. Blackie, Glasgow.</p> <p>WINFIELD I.J., ADAMS C.E., FLETCHER J.M. (1996) Recent introductions of the ruffe (<i>Gymnocephalus cernuus</i>) to three United Kingdom lakes containing <i>Coregonus</i> species. <i>Annales Zoologici Fennici</i>, 33: 459-466.</p> <p>WINFIELD I. J., FLETCHER J. M., JAMES J. B. & BEAN C. W. (2009) Assessment of fish populations in still waters using hydroacoustics and survey gill netting: Experiences with Arctic charr (<i>Salvelinus alpinus</i>) in the UK. <i>Fisheries Research</i>, 96: 30-38.</p>	
<p>2.4.14 Favourable reference population</p>	<p>a) Number of individuals/agreed exceptions/other units</p>	<p>107,261 individuals. This was the first proper estimate of the <i>C. lavaretus</i> population in Scotland. It was obtained over the period 2004-5</p> <p>This figure is the sum of the population estimates for Lochs Eck and</p>

	Lomond obtained over the period 2004-2005. It was the first complete proper quantitative survey of sites undertaken and represents the baseline for this species in Scotland.	
	It must be understood that this is a species which displays considerable inter-annual variation in recruitment and that it is unknown whether what status the population actually had at this time (i.e. whether it represented a period of high or low recruitment).	
	b) Operator	
	c) FRP is unknown indicated by "true"	False
	d) Method used to set FRP	
2.4.15 Reason for change Is the difference between the value reported at 2.4.1 or 2.4.2 and the previous reporting round mainly due to:	a) Genuine change?	False
	The overall population numbers presented in the previous reporting round were given on a 'per site' basis. When added to give a Scotland-wide estimate, this equated to 102,026 individuals. In the latest estimate (2007) this number was slightly higher 106,592. In fish population terms (and bearing in mind earlier comments about variable recruitment), this can be considered to be stable. However, it fails to recognise that there has been a slight rise in the number of fish in L. Eck and a considerable drop in the number of fish in L. Lomond. This may be due in part to the fact that recruitment is variable, the sampling technique may simply have underestimated the population because they are randomly spread throughout the waterbody, or there has been a genuine decline. This is not helped by the lack of data points available.	
	b) Improved knowledge/more accurate data?	False
	More data, obtained at shorter intervals and using the same survey technique is required	
	c) Use of different method (e.g. "Range tool")?	False
The survey method is sound and has been adopted by other agencies within the UK and Europe. The problem relates to sampling frequency not the methodology.		

2.5 Habitat for the species

2.5.1 Area estimation	<p>75.1</p> <p>Oligotrophic/mesotrophic lakes – Annex I habitats Oligotrophic waters containing very few minerals of sandy plains (<i>Littorelletalia uniflorae</i>); and Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i></p> <p>There is thought to be a sufficient amount of habitat in the UK to support a viable population of the species. Loch Eck – 4.6 km² Loch Lomond – 71.1 km² Total area occupied in Scotland 75.7 km²</p> <p>There is thought to be a sufficient amount of habitat in the UK to support a viable population of the species. This is dependent on maintenance of water quality. The presence of INNS and other factors (such as climate change) may make these habitats unsuitable over the long-term. As it currently stands, there is no reason why <i>C. lavaretus</i> will not persist in both sites.</p> <p>There is thought to be a sufficient amount of habitat in the UK to support a viable population of the species.</p>	
2.5.2 Year or period	2012-2012	
2.5.3 Method used Habitat for the species	<p>Complete survey/Complete survey or a statistically robust estimate</p> <p>All sites are known and their area has been calculated</p>	
2.5.4 Quality of the habitat	<p>a) Habitat quality</p> <p>b) Assessment method</p>	<p>Good</p> <p>Good (for essential parameters such as water quality) but with issues relating to INNS at one of the two sites</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>SEPA WFD water quality data assessment sheets for L. Eck (100272) and L. Lomond (100339 and 100257) – data collected 2010. (www.sepa.org.uk/water/river_basin_planning/waterbody_data_sheets.aspx)</p> <p>Habitat quality has been assessed by examining the quality of spawning grounds within the site – using a remote operating vehicle (ROV).</p> <p>Water quality (as determined by SEPA and published in their WFD water body data assessment sheets) suggests that there is little problem with the sites and there are no major land-use developments that pose an immediate risk to <i>C. lavaretus</i>.</p> <p>Habitat quality has been assessed by examining the quality of spawning grounds within the site – using a remote operating vehicle (ROV).</p> <p>Water quality (as determined by SEPA and published in their WFD water body data assessment sheets) suggests that there is little problem with the sites and there are no major land-use developments that pose an</p>

	<p>immediate risk to <i>C. lavaretus</i>.</p> <p>75.1 km²</p> <p>Habitat quality for <i>C. lavaretus</i> – good</p> <p>2007/8 – date of the latest SCM (Cycle II) report.</p> <p>ROV for spawning habitat quality (Etheridge 2009) – quality good.</p> <p>SEPA WFD water quality assessments – details given in 2.5.4 – quality good.</p> <p>The presence of ruffe (an INNS) in Loch Lomond presents the greatest risk to <i>C. lavaretus</i> in L. Lomond. Whilst not in itself a habitat variable, it does mean that L. Lomond as a habitat for <i>C. lavaretus</i> is compromised.</p>
2.5.5 Short-term trend Period	2004-2012
2.5.6 Short-term trend Trend direction	<p>0 to -</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in Loch Eck. Final Report. Report to Scottish Natural Heritage. LA/C02852/1. 22 pp.</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in standing waters (Phase II). Final Report. Report to Scottish Natural Heritage. LA/C02256/4. 40 pp.</p> <p>WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>SEPA WFD water quality data assessment sheets for L. Eck (100272) and L. Lomond (100339 and 100257) – data collected 2010. (www.sepa.org.uk/water/river_basin_planning/waterbody_data_sheets.a_spx)</p> <p>No sites have been lost, loch extent remains the same and water quality is High/Good using relevant chemical and biological indicators.</p> <p>As WFD measures come into force, the quality of the habitat will not deteriorate – remembering that ruffe, as a INNS have a negative impact on <i>C. lavaretus</i> in L. Lomond.</p>
2.5.7 Long-term trend Period	<p>It is not possible to provide a 24-year trend for this species because of the lack of comparable data over this period.</p> <p>For Loch Eck I would suggest that the long-term trend is stable for <i>C. lavaretus</i>.</p> <p>For Loch Lomond, the long-term trend is likely to be < from 1982 when ruffe were first recorded there.</p>
2.5.8 Long-term trend Trend direction	decrease
	- (based on the Loch Lomond population INNS situation), though the number of waterbodies occupied and their surface areas remain unchanged.

	<p>DAVIES, CE, SHELLEY, J, HARDING, PT, MCLEAN, IFG, GARDINER, R & PEIRSON, G (eds.) 2004. Freshwater fishes in Britain. The species and their distribution. Colchester: Harley Books</p> <p>MAITLAND, P.S. 2004 Keys to the Freshwater Fish of Britain and Ireland with notes on their distribution and ecology . Freshwater Biological Association , Scientific Publication No. 62, 245pp.</p> <p>MAITLAND, P.S. 2007 Scotland's Freshwater Fish: Ecology, Conservation & Folklore. Trafford Publishing, Oxford.</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009 It is not possible to provide a 24-year trend for this species because of the lack of comparable data over this period.</p> <p>For Loch Eck I would suggest that the long-term trend is stable for <i>C. lavaretus</i>.</p> <p>For Loch Lomond, the long-term trend is likely to be < from 1982 when ruffe were first recorded there.</p> <p>No 'trend calculation' has been carried out for habitat.</p> <p>- (based on the Loch Lomond population INNS situation), though the number of waterbodies occupied and their surface areas remain unchanged</p>	
<p>2.5.9 Area of suitable habitat for the species</p>	<p>a) Value in km²</p>	<p>Many standing waterbodies in Scotland > 2 km² may be suitable for this species. Lyle & Smith (1990) estimate this area to be 818.2 km² from 1:250,000 maps. A total of 75.1 km² is already occupied. 743.1 km² is unoccupied.</p> <p>LYLE, A.A. & SMITH, I.R. (1990) Standing waters. In: Maitland, P.S., Boon, P.J. & McLusky, D.S. eds.) The Freshwaters of Scotland: A national Resource of International Significance. pp. 35-50. John Wiley & Sons, Chichester.</p> <p>Two sites for this species in Scotland Loch Eck (4.6 km²) and Loch Lomond (71.1 km²).</p> <p>These are the only sites known to host native <i>C. lavaretus</i> and populations still exist there.</p> <p>No method used other than sampling the fish in known sites and measuring their area.</p> <p>LYLE, A.A. & SMITH, I.R. (1990) Standing waters. In: Maitland, P.S., Boon, P.J. & McLusky, D.S. eds.) The Freshwaters of Scotland: A national Resource of International Significance. pp. 35-50. John Wiley & Sons, Chichester.</p>
	<p>b) Absence of data indicated as '0'</p>	
	<p>2.5.10 Reason for change</p> <p>Is the difference between the value reported at 2.5.1 and the previous reporting round mainly due to</p>	<p>a) Genuine change?</p>
	<p>b) Improved knowledge/more accurate data?</p>	<p>False</p>

	c) Use of different method (e.g. "Range tool")?	False

2.6 Main pressures		
a) Pressure	b) Ranking	c) Pollution qualifier
	H = high importance M = medium importance L = low importance	
I01: invasive non-native species	H	
I02: problematic native species	H	
K03: Interspecific faunal relations	H	
M02: Changes in biotic conditions	H	
H01: Pollution to surface waters (limnic & terrestrial, marine & brackish)	M	
K01: abiotic (slow) natural processes	M	
M01: Changes in abiotic conditions	M	

Invasives are already a problem on one site (L. Lomond) where there is a direct and observable impact.

Climate change is an emerging issue and, in Loch Eck, we have already seen a decline in Arctic charr abundance which may be related to climate change (see: WINFIELD, I.J., HATELEY, J., FLETCHER, J.M., JAMES, B.J., BEAN, C.W. & CLABBURN, P. (2010) Population trends of Arctic charr (*Salvelinus alpinus*) in the UK: assessing the evidence for a widespread decline in response to climate change. *Hydrobiologia* 350, 55-65).

Both catchments contain agricultural and forestry coverage and some built development is also present. Both lochs are used as a water supply.

Invasives are already a problem on one site (L. Lomond) where there is a direct and observable impact from ruffe. It is impossible to remove ruffe from such a large waterbody.

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Both catchments contain agricultural and forestry coverage and some built development is also present. Both lochs are used as a water supply. These issues are being addressed through WFD obligations.

2.6.1 Method used – Pressures	based exclusively or to a larger extent on real data from sites/occurrences or other data sources
	WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in

	<p>Loch Eck. Final Report. Report to Scottish Natural Heritage. LA/C02852/1. 22 pp.</p> <p>WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in standing waters (Phase II). Final Report. Report to Scottish Natural Heritage. LA/C02256/4. 40 pp.</p> <p>WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611</p> <p>ETHERIDGE, E. Aspects of the conservation biology of <i>Coregonus lavaretus</i> in Britain. Unpublished PhD Thesis, University of Glasgow 2009</p> <p>WINFIELD, I.J., HATELEY, J., FLETCHER, J.M., JAMES, B.J., BEAN, C.W. & CLABBURN, P. (2010) Population trends of Arctic charr (<i>Salvelinus alpinus</i>) in the UK: assessing the evidence for a widespread decline in response to climate change. <i>Hydrobiologia</i> 350, 55-65</p>
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2.7 Threats		
a) Threat	b) Ranking	c) Pollution qualifier
	H = high importance M = medium importance L = low importance	
I01: invasive non-native species	H	
I02: problematic native species	H	
K03: Interspecific faunal relations	H	
M02: Changes in biotic conditions	H	
H01: Pollution to surface waters (limnic & terrestrial, marine & brackish)	M	
K01: abiotic (slow) natural processes	M	
M01: Changes in abiotic conditions	M	

Invasives are already a problem on one site (L. Lomond) where there is a direct and observable impact from ruffe. It is impossible to remove ruffe from such a large waterbody.

Climate change is an emerging issue and, in Loch Eck, we have already seen a decline in Arctic charr abundance which may be related to climate change (see: WINFIELD, I.J., HATELEY, J., FLETCHER, J.M., JAMES, B.J., BEAN, C.W. & CLABBURN, P. (2010) Population trends of Arctic charr (*Salvelinus alpinus*) in the UK: assessing the evidence for a widespread decline in response to climate change. *Hydrobiologia* 350, 55-65). Refuge populations have been established for *C. lavaretus* from Loch Lomond at Loch Sloy and

Carron Valley reservoir. Four more populations (two from L. Lomond and two from L. Eck) are being established by Scottish & Southern Energy.

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2.7.1 Method used – Threats

expert opinion

WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in Loch Eck. Final Report. Report to Scottish Natural Heritage. LA/C02852/1. 22 pp.

WINFIELD, I. J., FLETCHER, J. M., & JAMES, J. B. 2005. SCM of fish in standing waters (Phase II). Final Report. Report to Scottish Natural Heritage. LA/C02256/4. 40 pp.

WINFIELD, I.J. FLETCHER, J.M AND JAMES, B. (2008). Site Condition Monitoring of Fish in Standing Waters: Phase I (2007/8). Scottish Natural Heritage Commissioned Report ROAME No. R07AC611

ETHERIDGE, E. Aspects of the conservation biology of *Coregonus lavaretus* in Britain. Unpublished PhD Thesis, University of Glasgow 2009

WINFIELD, I.J., HATELEY, J., FLETCHER, J.M., JAMES, B.J., BEAN, C.W. & CLABBURN, P. (2010) Population trends of Arctic charr (*Salvelinus alpinus*) in the UK: assessing the evidence for a widespread decline in response to climate change. *Hydrobiologia* 350, 55-65.

2.8 Complementary information

2.8.1 Justification of % thresholds for trends

2.8.2 Other relevant information

The approach taken does not reflect the fact that this species is not sampled on an annual basis. Inferring trends from two data points, and with species which exhibits considerable inter-annual variations in recruitment is statistically unsafe. This has significant implications for the setting of FRV's based on the number of individuals. Using the number natural sites is very straightforward and high confidence. Improving any assessment based on the number of individuals can only be achieved by resourcing the collection of data at shorter intervals.

Assuming that nothing disastrous happens (in terms of climate change and presence of INNS), we do not anticipate that habitat extent will decrease by 2025.

Measures are in place to restrict the movement of INNS into these sites (though in the case of L. Lomond this has already happened), through the licensing of fish and other INNS movements through the Salmon & Freshwater Fish (Consolidation)(Scotland) Act 2003 and the Wildlife & Natural Environment Act 2012. Water quality and catchment issues are being addressed through the WFD package of measures for the River Basin District.

Climate change may impact these sites and we suspect that it

	<p>has already affected one species present in L. Eck. Refuge sites have been established at two sites (for L. Lomond fish) and more are in the process of being established (for both L. Lomond and L. Eck).</p> <p>The approach taken does not reflect the fact that this species is not sampled on an annual basis. Inferring trends from two data points, and with species which exhibits considerable inter-annual variations in recruitment is statistically unsafe. This has significant implications for the setting of FRV's based on the number of individuals. Using the number natural sites is very straightforward and high confidence. Improving any assessment based on the number of individuals can only be achieved by resourcing the collection of data at shorter intervals.</p> <p>Assuming that nothing disastrous happens (in terms of climate change and presence of INNS), we do not anticipate that habitat extent will decrease by 2025.</p> <p>Measures are in place to restrict the movement of INNS into these sites (though in the case of L. Lomond this has already happened), through the licensing of fish and other INNS movements through the Salmon & Freshwater Fish (Consolidation)(Scotland) Act 2003 and the Wildlife & Natural Environment Act 2012. Water quality and catchment issues are being addressed through the WFD package of measures for the River Basin District.</p> <p>Climate change may impact these sites and we suspect that it has already affected one species present in L. Eck. Refuge sites have been established at two sites (for L. Lomond fish) and more are in the process of being established (for both L. Lomond and L. Eck).</p> <p>Kottelat & Freyhof (2007) state that <i>Coregonus lavaretus</i> is not present in the UK and that what we actually call powan is actually <i>C. clupeioides</i> (the English Schelly was re-named <i>C. stigmanticus</i>, and the Gwyniad <i>C. pennantii</i>). This new taxonomy has been adopted by the IUCN and all three species appear in the IUCN Red List. We do not agree with this new taxonomy and have published a rebuttal (Etheridge et al. 2012), and are currently engaged in an examination of genetic evidence to support this view.</p> <p>ETHERIDGE, E.C., ADAMS, C.E., BEAN, C.W., DURIE, N. C., GOWANS, A. R. HARROD, C., LYLE, A.A., MAITLAND, P.S. & WINFIELD, I.J. (2012) Are phenotypic traits useful for differentiating among a priori <i>Coregonus</i> taxa?. <i>Journal of Fish Biology</i> 80, 387-407.</p> <p>KOTTELAT, M. & FREYHOF, J. (2007). <i>Handbook of European Freshwater Fishes</i>. Kottelat, Cornol, Switzerland and Freyhof, Berlin, Germany.</p>
2.8.3 Trans-boundary assessment	

2.9 Conclusions (*assessment of conservation status at end of reporting period*)

Please refer to the United Kingdom assessment for this species.

3 Natura 2000 coverage & conservation measures - Annex II species (only applies to species listed under Annex II of the Directive)

3.1 Population

3.1.1 Population size Estimation of population size included in the SAC network	a) Unit	
	b) Minimum	
	c) Maximum	
3.1.2 Method used		
3.1.3 Trend of population size within the network (short-term trend)		

3.2 Conservation measures

Conservation measures taken (i.e. already being implemented) within the reporting period and provided information about their importance, location and evaluation.

3.2.1 Measure	3.2.2 Type					3.2.3 Ranking H = high importance M = medium importance L = low importance	3.2.4 Location where the measure is PRIMARILY applied			3.2.5 Broad evaluation of the measure					
	a) Legal/statutory	b) Administrative	c) Contractual	d) Recurrent	e) One-off		a) Inside	b) Outside	c) Both inside & outside	a) Maintain	b) Enhance	c) Long term	d) No effect	e) Unknown	f) Not evaluated

