

**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:

S1029 - Freshwater pearl mussel. (*Margaritifera margaritifera*)

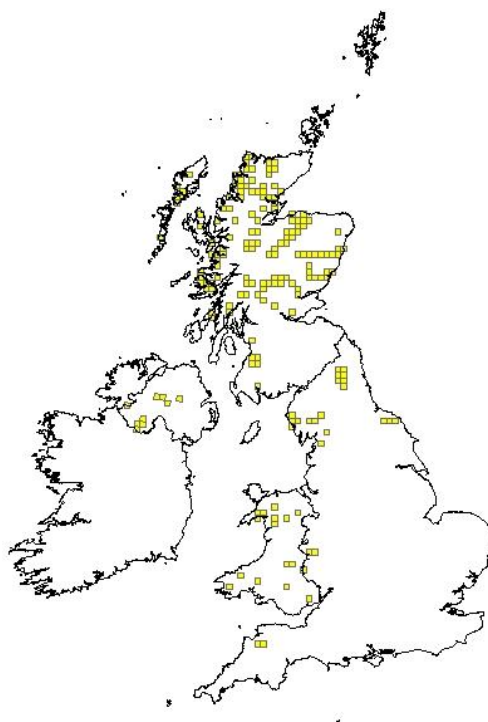
IMPORTANT NOTE – PLEASE READ

- 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 **Natural England** and refers only to the state of the habitat/species in **England** - 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	S1029
	0.2.2 Species scientific name	<i>Margaritifera margaritifera</i>
	0.2.3 Alternative species scientific name Optional	
	0.2.4 Common name Optional	Freshwater pearl mussel

1.1 Maps		
1.1.1 Distribution map		Sensitive True



1.1.2 Method used - map	<p>Complete survey/Complete survey or a statistically robust estimate</p> <p>The map is based on all recent survey data collected by the Environment Agency and Natural England and shows the current known distribution of pearl mussels in England. A number of populations have not been surveyed since 2006 and the distribution map is based on the latest full baseline survey available for each population. For some historic populations, we need to undertake new surveys to confirm the status of pearl mussels and these have not been included in the distribution map (classified as data deficient) - e.g. River Eden - main river.</p>
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1.1.3 Year or period	2007-2012
1.1.4 Additional distribution map	False
1.1.5 Range map	

2.1 Biogeographical region & marine regions	ATL
2.2 Published sources	<p>"ATKINS, 2012(a). River Clun SSSI/SAC Restoration Strategy: Technical Report, Version 3, February 2012. Report to Natural England.</p> <p>ATKINS, 2012(b), River Clun SSSI/SAC Restoration Strategy: Main Report, Version 3, March 2012. Report to Natural England.</p> <p>CAUWELIER, E., VERSPOOR E., TARR E. C., THOMPSON, C. & YOUNG M., 2009. Genetic diversity and differentiation of freshwater pearl mussel (<i>Margaritifera margaritifera</i>) populations in the UK. Scottish Natural Heritage Commissioned Report No.344 (ROAME No. F05AC701).</p> <p>COSGROVE, P., HASTIE, L. & Young, M., 2000. Freshwater pearl mussels in peril. British Wildlife June 2000, pp 340-347.</p> <p>CUTTELOD, A., SEDDON, M. & NEUBERT, E., 2011. European red list of non-marine molluscs. Luxembourg. Publications office of the European Union.</p> <p>Environment Agency, 2012. Freshwater pearl mussel prioritisation for the River Lune, Lancashire. Pre-assessment report. (unpublished report).</p> <p>E3 ECOLOGY LTD., 2006. Report on the 2006 survey of the freshwater pearl mussel (<i>Margaritifera margaritifera</i> L., 1758) in the Rivers Rede and North Tyne. Report for the Environment Agency.</p> <p>FOWLES, A., BARNFATHER, N. & MEASURES, G., 2010a. Rationale: A conservation plan for freshwater pearl mussel <i>Margaritifera margaritifera</i> populations in England and Wales. Countryside Council for Wales, Environment Agency and Natural England.</p> <p>FOWLES, A., BARNFATHER, N. & MEASURES, G., 2010b. Defining priorities: a conservation plan for freshwater pearl mussel <i>Margaritifera margaritifera</i> populations in England and Wales. Countryside Council for Wales, Environment Agency and Natural England.</p> <p>GEIST & AUERSWALD, 2007. Physicochemical stream bed characteristics and recruitment of the freshwater pearl mussel (<i>Margaritifera margaritifera</i>), <i>Freshwater Biology</i>, Volume 52, Issue 12, pages 2299–2316.</p> <p>GOSSELIN, M-P., MILES, L. & SWEETING, R., 2011. North Tyne Cttachment Desk Study. Tyne freshwater pearl mussel project. Freshwater Biological Association.</p> <p>HASTIE, L., COSGROVE, P., ELLIS, N. & Gaywood, J., 2003. The threats of climate change to freshwater paerl mussel populations. <i>Ambio</i> Vol. 32, No. 1, Feb 2003.</p>

JACKSON, W.J., 1925. The distribution of *Margaritifera margaritifera* in the British Isles. *Journal of Conchology*, Vol. 17, No. 7, March 1925.

JOINT NATURE CONSERVATION COMMITTEE , 2007. Second Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006: Conservation status assessment for S1029: *Margaritifera margaritifera* - Freshwater pearl mussel. Peterborough: JNCC.

KILLEEN, I.J., 1999a. A survey of selected Devon rivers for the freshwater pearl mussel *Margaritifera margaritifera* (L., 1758). Report to the Environment Agency.

KILLEEN, I.J., 1999b. A survey of the River Esk, Yorkshire for the freshwater pearl mussel *Margaritifera margaritifera* (L., 1758). Report to the Environment Agency.

Killeen, I.J. 2000. A survey of rivers in Cumbria and North Lancashire for the freshwater pearl mussel *Margaritifera margaritifera*. Report to the Environment Agency & English Nature.

KILLEEN, I.J., 2005. The Freshwater pearl mussel *Margaritifera margaritifera* (L.,1758) In the River Irt, Cumbria: Report on the 2005 survey and desktop study on prospects for recovery of the mussel population. Report to the Environment Agency.

KILLEEN, I.J., 2006a. Freshwater pearl mussel *Margaritifera margaritifera* (L.,1758) In the Dubbs Beck, Cumbria: Report on the 2006 survey. Report to English Nature.

KILLEEN, I.J., 2006b. Freshwater pearl mussel *Margaritifera margaritifera* (L.,1758) In the River Ehen, Cumbria: Report on the 2006 survey. Report to the Environment Agency.

KILLEEN, I.J., 2007a. A survey for freshwater pearl mussel *Margaritifera margaritifera* (L., 1758) at 129 RHS sites in the River Clun catchment, Shropshire. Unpublished report to the Environment Agency.

KILLEEN, I.J., 2007b. The freshwater pearl mussel *Margaritifera margaritifera* (L., 1758) in the River Ehen Cumbria: Report on the 2007 survey work.

KILLEEN, I.J., 2008a. A survey for the freshwater pearl mussel *Margaritifera margaritifera* (L.,1758) in the River Clun, Shropshire. Unpublished report to the Environment Agency.

KILLEEN, I.J., 2008b. The freshwater pearl mussel (*Margaritifera margaritifera*) (L., 1758) in Dubb's Beck, Cumbria. Report on the 2008 survey. Report to the Environment Agency.

KILLEEN, I.J., 2008c. The freshwater pearl mussel *Margaritifera margaritifera* (L., 1758) in the River Ehen Cumbria: Report on the survey work in the vicinity of Horse Gill, November 2008.

KILLEEN, I.J., 2009a. An assessment of the potential for the restoration of the freshwater Pearl mussel *Margaritifera margaritifera* (L., 1758) population in the River Clun, Shropshire. Unpublished report to the Shropshire Hills AONB Partnership.

KILLEEN, I.J., 2009b. A survey for the freshwater pearl mussel *Margaritifera margaritifera* (L., 1758) in the river Ehen Cumbria in sections downstream of the River Keekle confluence: November 2009. Report to Untied Utilities.

KILLEEN, I.J., 2011. A survey for the freshwater pearl mussel

	<p>Margaritifera margaritifera (L., 1758) in the River Ehen, Cumbria in sections at Longmoor. Report to Lake District National Park Authority, Nov 2011.</p> <p>KILLEEN, I.J. and Moorkens, E., 2013. Environmental monitoring of the River Ehen freshwater pearl mussel population in 2012. Malacological Servies. Report to United Utilities.</p> <p>KILLEEN, I.J. & OLIVER, P.G., 1997a. The freshwater pearl mussel [<i>Margaritifera margaritifera</i> (L., 1758)] in the River Ehen. Part 1. Report on the 1996 survey. English Nature Research Reports Series No. 226.</p> <p>KILLEEN, I.J. & OLIVER, P.G., 1997b. The freshwater pearl mussel [<i>Margaritifera margaritifera</i> (L., 1758)] in the River Ehen. Part 2. Distribution maps. English Nature Research Reports Series No. 226.</p> <p>KILLEEN, I.J. & OLIVER, P.G., 1998. A comparison of the populations of the freshwater pearl mussel [<i>Margaritifera margaritifera</i> (L., 1758)] in the Rivers Ehen and Irt. English Nature Research Reports Series No. 272.</p> <p>KILLEEN, I.J. & OLIVER, P.G., 2000. A survey of rivers in Cumbria and North Lancashire for the freshwater pearl mussel <i>Margaritifera margaritifera</i>. Report to the Environment Agency & English Nature.</p> <p>MAINSTONE, C.P. And CLARKE, S.J., 2008. Managing multiple stressors on sites with special protection for freshwater wildlife – the concept of Limits of Liability. <i>Freshwater Reviews</i>, 1, 175-187.</p> <p>MAINSTONE, C.P., 2010. An evidence base for setting nutrient targets to protect river habitat. Natural England Research Reports, Number 034.</p> <p>MAINSTONE, C.P, 2010. An evidence base for setting organic pollution targets to protect river habitat. Natural England Technical Information Note 076.</p> <p>MEASURES, G., 2009-2012. A series of monitoring reports on the freshwater pearl mussel population at Dubb's Beck (Cumbria). Confidential reports. Natural England.</p> <p>MEASURES, G. & GRANGE, J., 2012 (in prep). A survey for the freshwater pearl mussel <i>Margaritifera margaritifera</i> (L., 1758) in the river Ehen Cumbria in sections downstream of Ennerdale Bridge, August 2012. Natural England.</p> <p>NATURAL ENGLAND, 2012. England Catchment Sensitive Farming Initiative.</p> <p>Http://www.naturalengland.org.uk/ourwork/farming/csf/default.aspx.</p> <p>OLIVER, P.G. & KILLEEN, I.J., 1996. Report on the 1995 survey of the freshwater pearl mussel [<i>Margaritifera margaritifera</i> (L., 1758)]. Rivers Torridge, Clun, Esk, Irt, Ehen, Rede and N. Tyne. English Nature Research Report Series No. 162.</p> <p>OLIVER, P.G., MEECHAN, C.J. & TREW, A., 1993. Report on the 1992/93 survey of the freshwater pearl mussel (<i>Margaritifera margaritifera</i> L., 1758) in the River Wye. CCW Contract Science. 30. Countryside Council for Wales.</p> <p>SKINNER, A., YOUNG, M. & HASTIE, L. 2003. Ecology of the Freshwater Pearl Mussel. <i>Conserving Natura 2000 Rivers Ecology Series No. 2</i> English Nature, Peterborough.</p> <p>YOUNG, M. & WILLIAMS, J., 1983. The status and conservation</p>
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	<p>of the freshwater pearl mussel <i>Margaritifera margaritifera</i> Linn. In Great Britain. Biological Conservation 25, pp 35-52. YOUNG, M.R., HASTIE L.C. & COOKSLEY, S.L., 2003. Monitoring the Freshwater Pearl Mussel, <i>Margaritifera margaritifera</i>. Conserving Natura 2000 Rivers Monitoring Series No. 2, English Nature, Peterborough."</p>

2.3 Range					
2.3.1 Surface area Range	Overall, the range of freshwater pearl mussel in England has declined and the species is continuing to be lost from areas of suitable habitat within existing rivers due to general habitat degradation (e.g. Siltation, water quality, flow regime). There is little or no juvenile recruitment on the majority of rivers to replace adult losses and older adult mussels are being washed out into unsuitable or sub-optimal habitat during flood events.				
2.3.2 Method used Surface area of Range	Complete survey/ Complete survey or a statistically robust estimate				
2.3.3 Short-term trend Period	2001-2012 A number of distribution surveys have been undertaken in England within the reporting period, refer to 2.2				
2.3.4 Short term trend Trend direction	decrease For the period 2011 to 2012 pearl mussels were recorded from 24 10km squares. A number of populations (Rivers Brathay, Dubbs Beck and Lune) majority of mussels have now been taken into captivity - although a few old adults may still survive (effectively extinct in the wild).				
2.3.5 Short-term trend Magnitude	<table border="1"> <tr> <td>a) Minimum</td> <td></td> </tr> <tr> <td>b) Maximum</td> <td></td> </tr> </table>	a) Minimum		b) Maximum	
a) Minimum					
b) Maximum					
2.3.6 Long-term trend Period	1989-2012				
2.3.7 Long-term trend Trend direction	decrease Since 1989 pearl mussels have been recorded from 37 10km squares in England. The species is now assumed to be extinct in several rivers in SW and northern England.				
2.3.8 Long-term trend	a) Minimum				

Magnitude	Optional	
	b) Maximum	
2.3.9 Favourable reference range	a) Value in km²	
	b) Operator for FRR	
	c) FRR is unknown (indicated by "true")	False
	d) Method used to set FRR	Favourable reference range is the same as used in the 2007 Article 17 report.
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?	True
	b) Improved knowledge/more accurate data?	True
	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
	b) Minimum	595000
	c) Maximum	595000
2.4.2 Population size estimation (using population unit other than individuals)	a) Unit	number of localities

Optional (if 2.4.1 filled in)	b) Minimum	1
	Only one river in England is classed as having a viable population (i.e. juvenile recruitment).	
	c) Maximum	1
	Only one river in England is classed as having a viable population (i.e. juvenile recruitment).	
2.4.3 Additional information on population estimates / conversion Optional	a) Definition of "locality"	Rivers supporting viable populations (using the same definition of viable as in 2007 report)
	There has been no change in the population unit for England and the value used in 2007 report has been reused (i.e. no. of rivers supporting viable pops.).	
	b) Method to convert data	
	c) Problems encountered to provide population size estimation	
2.4.4 Year or period	2006-2012	
	Data collected from 2006 onwards has been used to make an informal estimate of the 2012 population size.	
2.4.5 Method used Population size	Complete survey/ Complete survey or a statistically robust estimate	
	The standard technique for freshwater pearl mussel survey includes total counts and quantitative assessments based on transect counts. These also entail searching for the presence of juvenile mussels as a sign of recent recruitment and population viability. See Young et al. 2003 for details on survey and monitoring methodologies for freshwater pearl mussels. Natural England freshwater pearl mussel dataset. The population size estimate is of viable populations in England. There are also other non-viable populations (ie. not recruiting populations) and extinct populations, and these make up the majority in rivers that are known to have supported freshwater pearl mussel populations 100 years ago.	
2.4.6 Short-term trend Period	2001-2012	
2.4.7 Short-term trend Trend direction	stable	
2.4.8 Short-term trend Magnitude	a) Minimum	
	b) Maximum	

	<p>Maximum short-term range is given as 3% per annum decrease in population size based on work undertaken in calculating extinction curves for the River Ehen populations (which holds 95% of the English FWPM population). This figure assumes no pollution incidents, no adult kill events, again optimistic. In other populations the short-term trend is even greater with losses of >5% per annum with likely chance that some populations will be lost in the medium term without direct intervention.</p>	
	c) Confidence interval	
2.4.9 Short-term trend Method used	Estimate based on partial data with some extrapolation and/or modelling	
2.4.10 Long-term trend – Period	1989-2012	
2.4.11 Long-term trend Trend direction	decrease	
	<p>There are few records of juvenile pearl mussels in England prior to 1995 but since systematic surveys have taken place there have been records of juvenile mussels present from three rivers (Ehen, Dubbs, Clun), indicating juvenile recruitment had taken place in the last 25 years. There are few records of juvenile pearl mussels in England prior to 1995 but since systematic surveys have taken place there have been records of juvenile mussels present from three rivers (Ehen, Dubbs, Clun), indicating juvenile recruitment had taken place in the last 25 years. However, since 2001 only one river in England now supports a recruiting population (i.e. juvenile mussels).</p>	
2.4.12 Long-term trend Magnitude	a) Minimum	
Optional	A number of distribution/count surveys have been undertaken in England within the reporting period, refer to 2.2	
	b) Maximum	
	A number of distribution/count surveys have been undertaken in England within the reporting period, refer to 2.2	
	c) Confidence interval	
2.4.13 Long term trend Method used	2	
2.4.14 Favourable	a) Number of individuals/agreed	1

reference population	exceptions/other units	
	b) Operator	
	c) FRP is unknown indicated by "true"	False
	d) Method used to set FRP	There has been no change in the Favourable Reference population for England and the value used in 2007 report has been reused (i.e. no. of rivers supporting viable pops.). However, the majority of populations in England are "functionally extinct" in that they consist of a relatively small number of old specimens with no substantial evidence of recent recruitment. At present only a single English river (the River Ehen, Cumbria) is considered to support a viable freshwater pearl mussel population (i.e. found to support juvenile pearl mussels) and in a further 10 rivers the species is considered to be in danger of extinction without significant intervention. Summary of population estimates: Population (number of rivers supporting populations in England) = 11; Number of populations believed to be viable in England: = 1.
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
	b) Improved knowledge/more accurate data?	False
	c) Use of different method (e.g. "Range tool")?	False

2.5 Habitat for the species							
2.5.1 Area estimation	<p>0</p> <p>The total area of rivers with the potential to support this species is unknown. No attempt has been made to map the area of habitat utilised by pearl mussels in English rivers. Habitat range does not tend to change as river habitat is generally not lost or gained - anthropogenic impacts tend to result in deterioration of the habitat rather than loss.</p> <p>It is unknown whether the amount of habitat in the UK is sufficient to support a viable population of the species.</p>						
2.5.2 Year or period	2007-2012						
2.5.3 Method used	Absent data						
2.5.4 Quality of the habitat	<table border="1"> <thead> <tr> <th>a) Habitat quality</th> <th>Bad</th> </tr> </thead> <tbody> <tr> <td colspan="2"> <p>Given that all English populations are in decline due to poor water quality and river morphology, this is taken to be symptomatic of wider habitat quality, and the conclusion is that it is bad. CSM data show that water quality and morphological damage are contributory factors to the unfavourable status of all SACs in England. Again this is likely to reflect wider issues with habitat quality for the species outside such sites.</p> <p>Whilst measures are being undertaken to improve habitat conditions in some pearl mussel rivers, they are likely to prove insufficient due to the demanding habitat requirements required for successful recruitment. Remaining individuals may well not be in the most favourable habitat within the catchment. In many cases, individuals are not in locations that are most amenable to improvement in habitat conditions to a point where recruitment is likely. For example, populations may be downstream of a large, intensive agricultural landscape with a large number of land owners and no legislative drivers to influence land-management changes in favour of the species.</p> <p>The conditions in which pearl mussels prosper, and hence are the desired outcome of recovery programmes, can be summarised as: 1. the majority of the catchment above the mussel population is under low-intensity land use. 2. nutrient status, water temperatures and fine sediment delivery are near-natural. 3. the risk of one-off acute pollution incidents is very low. 4. a natural flow regime which supplies adequate flows at times of natural drought. 5. channel geomorphology is highly natural and provides plentiful areas of clean coarse substrate. 6. the river contains a healthy population of host fish.</p> </td> </tr> <tr> <td>b) Assessment method</td> <td>Assessment based on regular water quality monitoring undertaken by the Environment Agency and condition monitoring of SSSI/SACs undertaken by Natural England.</td> </tr> </tbody> </table>	a) Habitat quality	Bad	<p>Given that all English populations are in decline due to poor water quality and river morphology, this is taken to be symptomatic of wider habitat quality, and the conclusion is that it is bad. CSM data show that water quality and morphological damage are contributory factors to the unfavourable status of all SACs in England. Again this is likely to reflect wider issues with habitat quality for the species outside such sites.</p> <p>Whilst measures are being undertaken to improve habitat conditions in some pearl mussel rivers, they are likely to prove insufficient due to the demanding habitat requirements required for successful recruitment. Remaining individuals may well not be in the most favourable habitat within the catchment. In many cases, individuals are not in locations that are most amenable to improvement in habitat conditions to a point where recruitment is likely. For example, populations may be downstream of a large, intensive agricultural landscape with a large number of land owners and no legislative drivers to influence land-management changes in favour of the species.</p> <p>The conditions in which pearl mussels prosper, and hence are the desired outcome of recovery programmes, can be summarised as: 1. the majority of the catchment above the mussel population is under low-intensity land use. 2. nutrient status, water temperatures and fine sediment delivery are near-natural. 3. the risk of one-off acute pollution incidents is very low. 4. a natural flow regime which supplies adequate flows at times of natural drought. 5. channel geomorphology is highly natural and provides plentiful areas of clean coarse substrate. 6. the river contains a healthy population of host fish.</p>		b) Assessment method	Assessment based on regular water quality monitoring undertaken by the Environment Agency and condition monitoring of SSSI/SACs undertaken by Natural England.
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b) Assessment method	Assessment based on regular water quality monitoring undertaken by the Environment Agency and condition monitoring of SSSI/SACs undertaken by Natural England.						
2.5.5 Short-term trend	2001-2012						

Period							
2.5.6 Short-term trend	decrease						
Trend direction	<p>Quantitative habitat trend data for this species is only available for SSSI/SACs since the last reporting round, expert opinion is that habitat quality will most likely have declined outside protected sites.</p> <p>However it is important to note that freshwater pearl mussels are extremely sensitive to changes in some habitat determinands (e.g. nutrients, organic pollution). Outside Special Areas of Conservation, such determinands are controlled and regulated in accordance with the aims of the Water Framework Directive. It is considered that the habitat requirements of the freshwater pearl mussel are so high that much of the restorative action required to meet WFD objectives (i.e. good ecological status) will be insufficient to restore the habitat such that freshwater pearl mussel populations will become viable. For this species, this is an important policy gap at present.</p>						
2.5.7 Long-term trend	1989-2012						
Period							
2.5.8 Long-term trend	decrease						
Trend direction	<p>The long-term trend in habitat has been reported as decreasing due to the continuing decline in pearl mussel populations over this period. Historically, organic and industrial pollution have degraded freshwater habitat across England. Although pollution levels have been reduced in recent decades (as a result of a decline in heavy industry and investment in the treatment of sewage effluent), diffuse sources of pollution (nutrients and sediments) from wider catchment management has become the main cause of habitat degradation and reported declines in pearl mussel populations.</p> <p>The long-term trend in habitat has been reported as decreasing due to the continuing decline in pearl mussel populations over this period. Historically, organic and industrial pollution have degraded freshwater habitat across England. Although pollution levels have been reduced in recent decades (as a result of a decline in heavy industry and investment in the treatment of sewage effluent), diffuse sources of pollution (nutrients and sediments) from wider catchment management has become the main cause of habitat degradation and reported declines in pearl mussel populations.</p>						
2.5.9 Area of suitable habitat for the species	<table border="1"> <tr> <td>a) Value in km²</td> <td>0</td> </tr> <tr> <td colspan="2">It is not possible to estimate the extent of suitable habitat without country-wide river surveys, specifically designed to assess the habitat characteristics known to be favourable to pearl mussels. See also comment under 2.5.1.</td> </tr> <tr> <td>b) Absence of data indicated as '0'</td> <td></td> </tr> </table>	a) Value in km²	0	It is not possible to estimate the extent of suitable habitat without country-wide river surveys, specifically designed to assess the habitat characteristics known to be favourable to pearl mussels. See also comment under 2.5.1.		b) Absence of data indicated as '0'	
a) Value in km²	0						
It is not possible to estimate the extent of suitable habitat without country-wide river surveys, specifically designed to assess the habitat characteristics known to be favourable to pearl mussels. See also comment under 2.5.1.							
b) Absence of data indicated as '0'							
2.5.10 Reason for change	<table border="1"> <tr> <td>a) Genuine change?</td> <td>True</td> </tr> <tr> <td colspan="2">Is the difference between the value reported at 2.5.1 and the previous reporting round mainly due to</td> </tr> <tr> <td>b) Improved knowledge/more</td> <td>False</td> </tr> </table>	a) Genuine change?	True	Is the difference between the value reported at 2.5.1 and the previous reporting round mainly due to		b) Improved knowledge/more	False
a) Genuine change?	True						
Is the difference between the value reported at 2.5.1 and the previous reporting round mainly due to							
b) Improved knowledge/more	False						

	accurate data?	
	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	
A02: modification of cultivation practices	H	
A04: grazing	H	
F03: Hunting and collection of wild animals (terrestrial)	H	
H01: Pollution to surface waters (limnic & terrestrial, marine & brackish)	H	NOPTX
J02: human induced changes in hydraulic conditions	H	
A01: Cultivation	M	
A06: annual and perennial non-timber crops	M	
B02: Forest and Plantation management & use	M	A
C03: Renewable abiotic energy use	M	
D01: Roads, paths and railroads	M	X
E01: Urbanised areas, human habitation	M	
I01: invasive non-native species	M	
J03: Other ecosystem modifications	M	
G01: Outdoor sports and leisure activities, recreational activities	L	

Pearl mussel declines in England are attributed to: i) continuing changes in the physical and chemical conditions of their river habitat (e.g. poor water quality, including nutrient enrichment; sedimentation caused by catchment overgrazing, forestry activities and other land management practices; habitat removal and alteration through drainage schemes, water abstraction, flow regulation and fisheries management); (ii) increased disturbance aided by improved accessibility; (iii) spread of invasive species and diseases (e.g. Himalayan balsam and *Phytophthora*) impacting on riparian and in-channel habitats and (iv) fishery management practices such as re-stocking and a decline in the numbers of juvenile salmon and trout, which provide the hosts for pearl mussel larvae.

F - Hunting and collections. Historically, pearl fishing has had a direct impact on populations in England

which led to loss of some populations (e.g. River Mite in Cumbria) and reduced population size in a number of rivers . However, there has been no reported cases in England of pearl fishing since the late 1990s. This pressure has been ranked high due to the impact this may have of remaining populations due to the low numbers of adult mussels.

C - Linked to comments on J below. Hydropower generation has become a concern since the last Article 17 report (e.g. Specific hydropower release patterns from Kielder Reservoir are responsible for the failure of pearl mussels to inhabit the upstream sections on the North Tyne (Gosselin, 2011)). The conflicting objectives of renewable energy generation to help combat climate change on the one hand, and the need to restore the morphological and hydrological condition of river habitat on the other (in part to improve resilience to climate change), present a major challenge.

J – Natural system modifications – Physical habitat modifications and modifications to the natural flow regime are extensive. Historical channel modifications have created loss of river length, reduced habitat complexity, stabilised water levels and siltation, leading to loss of a range of habitat niches including in-channel habitats. In-channel impounding structures have also restricted biological movements of salmonid fish. Flow modifications due to flow regulation, diversion and abstraction have generally reduced the level of rheophilism in the biological community, affecting plants, fish and invertebrates adapted to high current velocities. Abstraction and diversion also affects habitat extent, resulting in rivers of smaller size as well as power.

H – Pollution – Wide range of pollutant types and pollution sources, varying in importance from site to site. Eutrophication, organic pollution, enhanced sediment loads, toxic pollution, acidification. All have their characteristics effects on the characteristic biota of the habitat. Some are widespread (e.g. eutrophication) and some relatively localised (e.g. toxic pollution). For descriptions of effects of nutrient enrichment and organic pollution see references in 2.2.

2.6.1 Method used – Pressures	based exclusively or to a larger extent on real data from sites/occurrences or other data sources
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2.7 Threats		
a) Threat	b) Ranking	c) Pollution qualifier
	H = high importance M = medium importance L = low importance	
A02: modification of cultivation practices	H	
A04: grazing	H	
H01: Pollution to surface waters (limnic & terrestrial, marine & brackish)	H	NOPTX
J02: human induced changes in hydraulic conditions	H	
M01: Changes in abiotic conditions	H	
A01: Cultivation	M	

A06: annual and perennial non-timber crops	M	
B02: Forest and Plantation management & use	M	A
C03: Renewable abiotic energy use	M	
D01: Roads, paths and railroads	M	X
E01: Urbanised areas, human habitation	M	
F03: Hunting and collection of wild animals (terrestrial)	M	
I01: invasive non-native species	M	
J03: Other ecosystem modifications	M	
K05: reduced fecundity/ genetic depression	M	
G01: Outdoor sports and leisure activities, recreational activities	L	

The threats are essentially the same as the pressures listed under 2.6. The additional ones are changes in abiotic conditions due to climate change (increased frequency of droughts and flooding impacting on juvenile recruitment) and reduced fecundity/genetic depression due to very low population sizes of the majority of the remaining English populations.

M - Climate change – Climate change is set to alter the hydrological and thermal regimes of the habitat, and through altered patterns of run-off the delivery of diffuse pollutants. Possible increases in flood risk as a result of flashier rainfall events may lead to increased pressure to further engineer channels and banks, although there is a balancing pressure that is moving flood management to a catchment-based approach working with natural processes. The nature of the habitat will change as a result of climate change which may have a direct impact on the species distribution as a result.

2.7.1 Method used – Threats expert opinion

2.8 Complementary information

2.8.1 Justification of % thresholds for trends

2.8.2 Other relevant information

Recent genetic analysis has indicated that the British pearl mussel populations show evidence of two distinct phylogenetic groups (one comprising Scotland and northern England and the other consisting of the remaining English and the Welsh

	<p>populations). The demarcation of these 'ecological units' runs through south Cumbria, such that (of the SACs) the Ehen is included in the northern ecological unit and Dubbs Beck, the Clun are in the southern ecological unit (Cauwelier et al. 2009). There are no SACs representing the southern ecological unit that are currently considered to be in viable condition. This has implications for the UK's ability to report on Favourable Conservation Status for the freshwater pearl mussel.</p>
	<p>A preliminary survey was made of the genetic diversity and differentiation between pearl mussel populations across the UK in 2009 (Cauwelier et al.2009). DNA was collected from over 1600 individuals in 59 locations across the UK. Observed genetic variation was analysed to assess levels of diversity, population structuring and the phylogenetic status of the populations. Comparisons were made between the Scotland, England and Wales. Genetic variability is considered to be a general indicator of long-term population viability. As such, populations with higher levels of diversity can be assumed to be "healthier", i.e. be more likely to be able to adapt to future environmental changes, such as those associated with global warming. It is therefore important that populations are protected so as to avoid further losses of diversity; this is particularly important for those in England and Wales which show much lower levels of variability than most populations in Scotland. Based on this study, most Scottish populations and the North Tyne and Ehen in England fall into the category of large population size and high diversity, whilst the majority of the other English and all the Welsh populations can be classified as small populations with either high or low diversity.</p>
<p>2.8.3 Trans-boundary assessment</p>	<p>The only trans-boundary site is the River Wye which flows from Wales into England. Historically, the Wye has supported a large mussel population in the 1970s. In 1992/93 CCW & NMW collaborated to undertake a survey of the whole length of the Wye (Oliver et al 1993). Eighty sites were investigated but only six contained mussels and a total of only 21 individuals were found (four in England, 17 in Wales). All of these were over 70mm in length, suggesting that there had been no recruitment for at least 30 years. The survey report concluded that the freshwater pearl mussel was on the verge of extinction on the Wye, suggesting that there was unlikely to be more than 2-300 mussels left in the whole river. The cluster of 12 mussels at Lowes was resurveyed the following year (Oliver 1994) and all mussels were still present, but a recent survey (2003) by EA staff found only six left at this location.</p>

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

Please refer to the United Kingdom assessment for this species.

	<p>class since the 1996 baseline survey, with the adults now 10 years older. Mussels less than 65mm were found to comprise less than 1.5% of the overall population. Juveniles less than 10mm (4yr old) were rare and only four in the most oxygenated riffles. The lack of young mussels in the population of this size shows that there is barely any recruitment. Overall the 2006 survey results showed that the river was in unfavourable condition for FWPM's as there is insufficient recruitment, resulting in an aging population. Further work undertaken in 2007/2008 showed similar results to the 2006 survey. The results shows that numbers of mussels up to 90mm in length were present in higher numbers in the 1996 survey, and mussels greater than 90mm in length were present in higher numbers in the 2006 and 2007 surveys. The change at 90mm is important as it signifies a loss of mussels in the younger age groups (0-35 years old), compared with older specimens. Surveys from other sites demonstrate that younger mussels, not just small juveniles, are more vulnerable to stress and death than older mussels. Thus the loss of 0-90mm mussels in 2006 corresponds to a loss of the mussels that were 0 to 25 years old in 1996.</p> <p>A recent incident on the River Ehen in 2012 as a result of low flows resulted in significant stress to the majority of the mussel population in the upper reaches (where 90% of the total Ehen population are located). Juvenile searches were undertaken after the incident and no juvenile mussels less than 30mm were found in any of the wider juvenile habitat areas where the vast majority of adult mussels are found. The results of monitoring transects mussel counts carried out in 2012 show a decline with respect to pearl mussel numbers in the same transects in earlier years. The average estimated decline was 31.5% loss of adult mussels in these transects. However, mussels count were carried out during the time of very poor habitat conditions. The transects will be carried out under good conditions in order to determine whether this level of loss is genuine.</p>
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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

2.2: Adapting crop production				Y		H			Y		Y	Y			
4.1: Restoring/im proving water quality	Y					H			Y		Y	Y			
4.2: Restoring/im proving the hydrological regime				Y		H			Y		Y	Y			
4.3: Managing water abstraction	Y					H			Y		Y	Y			
6.1: Establish protected areas/sites	Y					M			Y		Y	Y			
6.3: Legal protection of habitats and species	Y					M			Y		Y	Y			
7.4: Specific single species or species group managemen t measures			Y			H			Y		Y	Y			
8.0: Other measures					Y	M			Y		Y	Y			

2.2 Adapting crop production - the England Catchment Sensitive Farming Initiative is continuing to promote a range of best agricultural practices to reduce pollution loads to priority aquatic sites, including a range of river SACs and nationally designated rivers (see link in 2.2 for further details). The initiative is voluntary and uses awareness-raising and incentives to bring about management change. Modelling has predicted benefits in terms of reduced pollution loads, but it is

still unclear how far a voluntary approach will go towards achieving favourable conditions for the freshwater pearl mussel and its habitat.

4.1 Restoring/improving water quality - in addition to Catchment Sensitive Farming, work has continued to implement the review of discharge consents affecting the Natura network in England. Further phosphorus removal processes have been fitted to sewage effluents under the water industry's programme of strategic improvements. However, further investigations are needed into the application of new best available technology for phosphorus removal, as well as the need for action on rural unsewered populations. Plans are being drawn up for addressing these issues in relation to SACs and nationally designated sites.

6.1. Establish protected areas/sites - 3 SACs (River Ehen, River Kent and River Clun) that have been designated to protect the species. A further population has recently been confirmed on the River Eden SAC/SSSI but is not a notified feature (Swindale Beck). Natural England is currently undertaking

a SSSI notification review, which includes a commitment to review existing SSSI network (e.g. Coverage and gaps) alongside a review to establish a better, more representative and more resilient series of sites in England. Within the river SAC network, considerable effort has been expended on the development and implementation of strategic plans aimed at restoring the condition of the river habitat, including pearl mussels (see Atkins 2012 as an example in 2.2). Beyond the designated site network, management measures for pearl mussels will largely be governed by the Water Framework Directive. Within the first round of river basin management planning, a considerable amount of WFD-related effort is being expended on confirming, and investigating the causes of problems with, ecological status. Better harmonisation of plans and activities under the WFD and Habitats Directive is needed (see Mainstone 2008 in 2.2 for further discussion of harmonisation issues).

6.3. Legal protection - the freshwater pearl mussel is fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). Legal protection makes it an offence to deliberately disturb them, remove them from their habitat, kill mussels and to fish for or sell pearls, as is damaging or destroying their habitat. The species is also included on the Government's list of "species of principal importance for the conservation of biodiversity" in England and thus requires special attention (Section 41 Natural Environment and Rural Communities Act 2006).

7.4 Single species measures - in 2007, Natural England in partnership with the Environment Agency and the Freshwater Biological Association established a national holding facility and captive breeding programme for the conservation of threatened populations of freshwater pearl mussels in England. The project has two main objectives: 1. to create an 'ark' facility for some threatened English pearl mussel populations to safeguard against further local extinction and, 2. to subsequently breed from some captive populations in order to release juveniles and/or encysted fish back to the wild. The ark has now been established for 5 years and has sub-populations from 9 English rivers.

8.0 Other measures - in 2010, CCW/EA/NE published "A Conservation Plan for freshwater pearl mussel *Margaritifera margaritifera* populations in England and Wales". The conservation plan established the main drivers applicable to the conservation of freshwater pearl mussel populations in England and Wales. It is envisaged that these drivers will help us to prioritise conservation action on the ground at a local and national level. A companion document was also published alongside "Defining priorities for conservation action for freshwater pearl mussel *Margaritifera margaritifera* populations in England and Wales". This sets out the criteria to decide whether a population is likely to achieve restoration targets, and therefore whether conservation action is a feasible option for individual populations.