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

Fourth Report by the United Kingdom under Article 17

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

Supporting documentation for the
conservation status assessment for the species:

S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*)

SCOTLAND

IMPORTANT NOTE - PLEASE READ

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

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

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

NATIONAL LEVEL

1. General information

1.1 Member State	**UK (Scotland information only)**
1.2 Species code	**1029**
1.3 Species scientific name	**Margaritifera margaritifera**
1.4 Alternative species scientific name	
1.5 Common name (in national language)	Freshwater pearl mussel

2. Maps

2.1 Sensitive species	No
2.2 Year or period	1999-2018
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

Margaritifera margaritifera is illegally persecuted in Scotland, despite full legal protection. Because of this the species is a UK wildlife crime priority with significant resources dedicated to raising awareness of the impact wildlife crime has on the species' conservation status and to reduce this threat.

BIOGEOGRAPHICAL LEVEL

4. Biogeographical and marine regions

4.1 Biogeographical or marine region where the species occurs

Atlantic (ATL)

4.2 Sources of information

Watt, J, Cosgrove, P.J & Hastie, L.C. 2015. A national freshwater pearl mussel (Margaritifera margaritifera, L.) survey of Scotland. Scottish Natural Heritage Commissioned
Report No. 901.
Baum, D. 2018. Host salmonid specificity of selected pearl mussel populations. Scottish
Natural Heritage Research Report No. 972.
Watt, J., Hastie, L.C., and Cosgrove, P.J. 2018. Monitoring the success of freshwater pearl
mussel reintroductions. Scottish Natural Heritage Research Report No. 956.
Pearls in Peril 2013. Encystment monitoring
Pearls in Peril 2017. Final project report
Scottish Natural Heritage 2018. Unpublished Site Condition Monitoring survey, Rannoch Moor SAC.
Cooksley, S.L., Addy, S., Watson H. and Johnstone, L. (2011). Fluvial audit of the upper
River Moriston. Scottish Natural Heritage Commissioned Report No. 477.
Irene Tierney, IMTECO Ltd. Freshwater Pearl Mussel Survey, October 2015
COSGROVE, P. 2017. FRESHWATER PEARL MUSSEL SURVEY, 2017. CNPA COMMISSIONED REPORT
COSGROVE, P. & SHIELDS, D. 2016. FRESHWATER PEARL MUSSEL SURVEY. JBA COMMISSIONED REPORT.

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Direct Ecology 2016. Freshwater pearl mussel survey
HEL Ltd 2016. Freshwater pearl mussel survey & species protection plan
Esk Rivers and Fisheries Trust. 2010. Freshwater pearl mussel survey
Cosgrove, P.J., Hastie, L.C. and Watt, J. 2017. Surveys of high risk freshwater pearl mussel populations. Report to SNH.
Galloway Fisheries Trust. 2016. Survey to determine presence of freshwater pearl mussels in Galloway. Report to SNH
Cosgrove, P. 2013. Shetland 2012 Freshwater Pearl Mussel Survey. Report to SNH
COSGROVE, P., FARQUHAR, J. AND COSGROVE, C. 2013 RVER XX FRESHWATER PEARL MUSSEL SURVEY. ALBA ECOLOGY
Cosgrove, P.J. 2016. Site Condition Monitoring of freshwater pearl mussels in the Inverpolly Special Area of Conservation. Report to SNH.
Sime, 2014. Report of Site Condition Monitoring survey of freshwater pearl mussels in the River Spey during 2013 and 2014. SNH report
Barnes. M. 2015. Effects of depth and current on Freshwater pearl mussel (Margaritifera margaritifera) in a Scottish river. University of Oxford
Baum, 2013 Assessment of the Ardnamurchan Burns Special Area of Conservation. Report to SNH
Cosgrove, P., Watt, J., Hastie, L. et al. Biodivers Conserv (2016) 25: 2093.
Mertens, C. 2018. SCM surveys of freshwater SACs in Lochaber. Internal, unpublished results

5. Range

5.1 Surface area (km²)		
5.2 Short-term trend Period		
5.3 Short-term trend Direction	Decreasing (-)	
5.4 Short-term trend Magnitude	a) Minimum	b) Maximum
5.5 Short-term trend Method used		
5.6 Long-term trend Period		
5.7 Long-term trend Direction		
5.8 Long-term trend Magnitude	a) Minimum	b) Maximum
5.9 Long-term trend Method used		
5.10 Favourable reference range	a) Area (km²) 1296 b) Operator c) Unknown d) Method	
5.11 Change and reason for change in surface area of range	Genuine change Improved knowledge/more accurate data Use of different method The change is mainly due to: Genuine change	
5.12 Additional information	There have been an important number of new populations recorded within the last 6 years in Scotland. However a number of important populations have become extinct, notably populations in Aberdeenshire and Moray, that mean the specie's range of extant populations in NE Scotland has contracted.	

6. Population

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6.1 Year or period	1999-2018	
6.2 Population size (in reporting unit)	a) Unit	number of map 1x1 km grid cells (grids1x1)
	b) Minimum	
	c) Maximum	
	d) Best single value	1251
6.3 Type of estimate	Best estimate	
6.4 Additional population size (using population unit other than reporting unit)	a) Unit	number of colonies (colonies)
	b) Minimum	
	c) Maximum	
	d) Best single value	71
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	1999-2018	
6.8 Short-term trend Direction	Decreasing (-)	
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	1296 with unit N/A
	b) Operator	
	c) Unknown	
	d) Method	
6.16 Change and reason for change in population size	Genuine change Improved knowledge/more accurate data Use of different method	
	The change is mainly due to:	Improved knowledge/more accurate data
6.17 Additional information		

7. Habitat for the species

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7.1 Sufficiency of area and quality of occupied habitat	a) Are area and quality of occupied habitat sufficient (to maintain the species at FCS)?	No
	b) Is there a sufficiently large area of occupied AND unoccupied habitat of suitable quality (to maintain the species at FCS)?	No
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	1999-2018	
7.4 Short-term trend Direction	Uncertain (u)	
7.5 Short-term trend Method used	Based mainly on expert opinion with very limited data	
7.6 Long-term trend Period	1999-2018	
7.7 Long-term trend Direction	Decreasing (-)	
7.8 Long-term trend Method used	Based mainly on extrapolation from a limited amount of data	
7.9 Additional information	There has been considerable investment in habitat improvements for the species - mainly within the Natura network. Populations that have become extinct since 1999 have all been outwith the Natura network. Some populations are now recovering, indicating improved habitat. But not on a sufficiently wide scale to provide an overall improving trend.	

8. Main pressures and threats

8.1 Characterisation of pressures/threats

Pressure	Ranking
Agricultural activities generating diffuse pollution to surface or ground waters (A26)	H
Forestry activities generating pollution to surface or ground waters (B23)	H
Illegal harvesting, collecting and taking (G11)	H
Modification of hydrological flow (K04)	M
Physical alteration of water bodies (K05)	H
Increases or changes in precipitation due to climate change (N03)	M
Other impacts from marine aquaculture, including infrastructure (G19)	M
Intensive grazing or overgrazing by livestock (A09)	M

Threat	Ranking
Agricultural activities generating diffuse pollution to surface or ground waters (A26)	H
Forestry activities generating pollution to surface or ground waters (B23)	H
Illegal harvesting, collecting and taking (G11)	H
Modification of hydrological flow (K04)	M
Physical alteration of water bodies (K05)	M

Increases or changes in precipitation due to climate change (N03)	H
Intensive grazing or overgrazing by livestock (A09)	M
Temperature changes (e.g. rise of temperature & extremes) due to climate change (N01)	M
Introduction and spread of species (including alien species and GMOs) in freshwater aquaculture (G24)	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: Restore the habitat of the species (related to 'Habitat for the species')

9.3 Location of the measures taken: Only inside 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

- Reduce/eliminate point pollution to surface or ground waters from agricultural activities (CA10)
- Reduce diffuse pollution to surface or ground waters from forestry activities (CB10)
- Control/eradication of illegal killing, fishing and harvesting (CG04)
- Implement climate change adaptation measures (CN02)
- Other measures to reduce impacts from marine aquaculture infrastructures and operation (CG09)
- Adapt/manage reforestation and forest regeneration (CB04)
- Other measures related to natural processes (CL04)

9.6 Additional information

10. Future prospects

10.1 Future prospects of parameters

a) Range

b) Population

c) Habitat of the species

10.2 Additional information

11. Conclusions

11.1. Range

11.2. Population

11.3. Habitat for the species

11.4. Future prospects

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11.5 Overall assessment of Conservation Status	
11.6 Overall trend in Conservation Status	
11.7 Change and reasons for change in conservation status and conservation status trend	a) Overall assessment of conservation status No change The change is mainly due to: b) Overall trend in conservation status No change The change is mainly due to:
11.8 Additional information	

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

12.1 Population size inside the pSCIs, SCIs and SACs network (on the biogeographical/marine level including all sites where the species is present)	a) Unit	number of map 1x1 km grid cells (grids1x1)
	b) Minimum	
	c) Maximum	
	d) Best single value	809
12.2 Type of estimate	Best estimate	
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	Decreasing (-)	
12.5 Short-term trend of population size within the network Method used	Complete survey or a statistically robust estimate	
12.6 Additional information		

13. Complementary information

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

Distribution Map

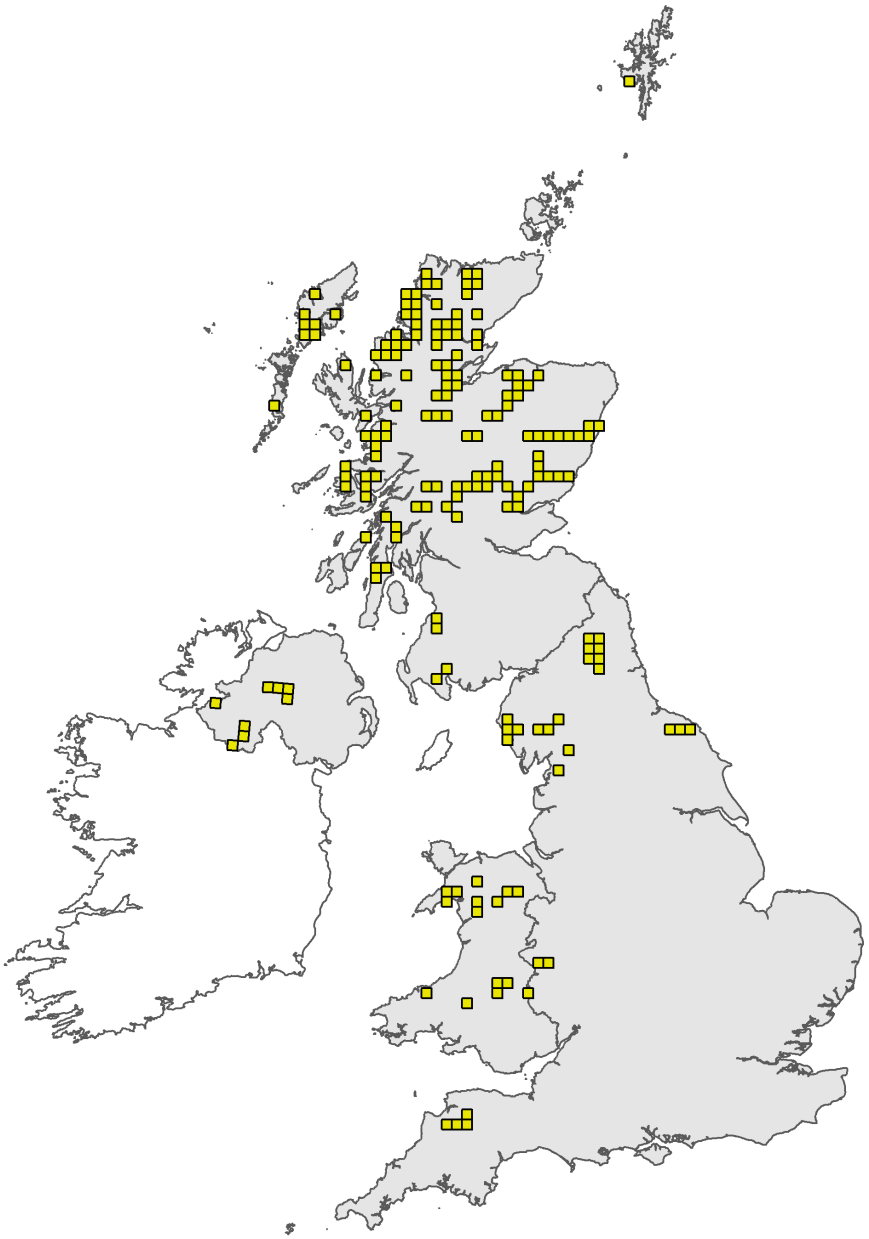

Figure 1: UK distribution map for S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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

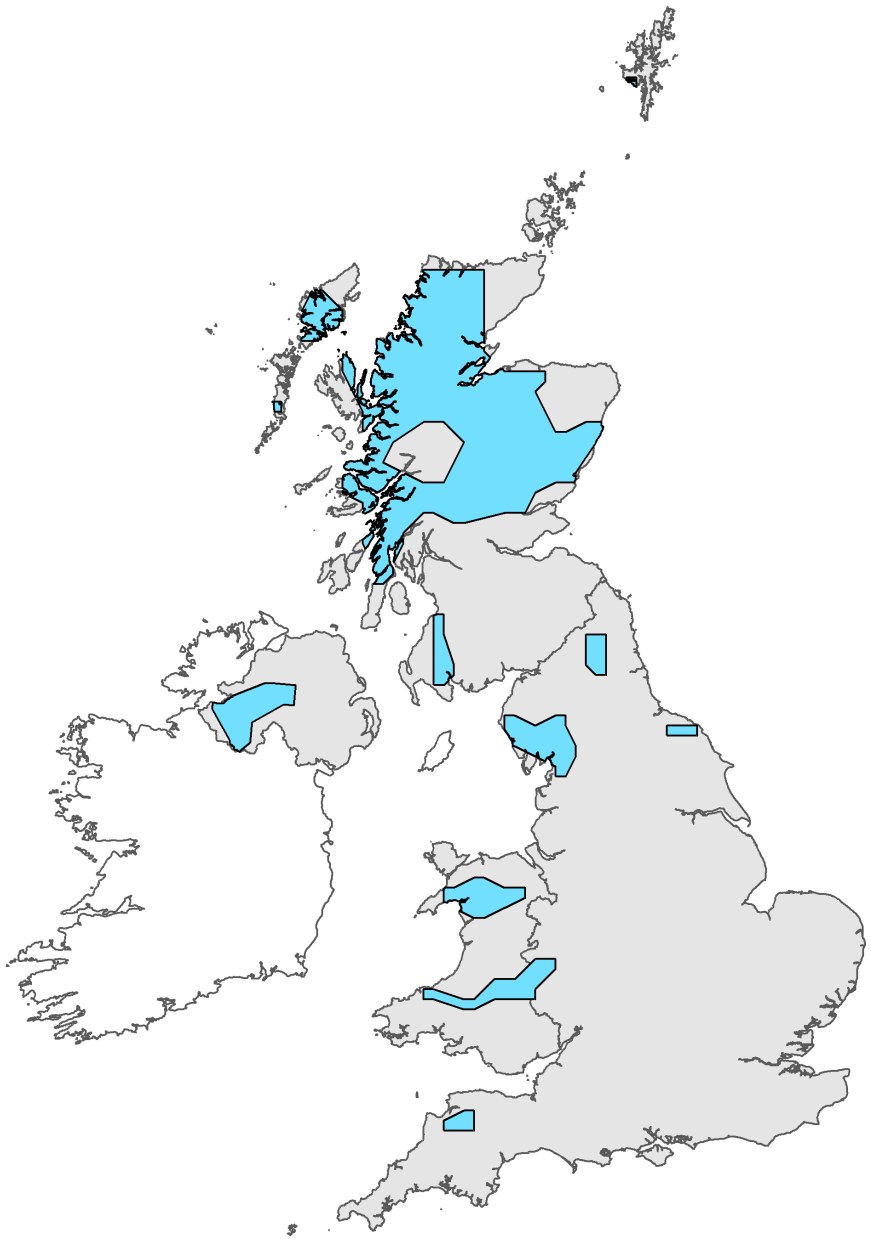

Figure 2: UK range map for S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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 25km. For further details see the 2019 Article 17 UK Approach document.

Explanatory Notes

Species name: Margaritifera margaritifera (1029) Region code: ATL

Field label	Note
5.3 Short term trend; Direction	The last national survey (2015) found that pearl mussel populations had been lost from a number of rivers. In the last Art 17 reporting round, a total of 72 recruiting populations were recorded. In 2016, a total of 71 recruiting populations were recorded. More widely (considering both recruiting and non-recruiting populations), since 1999 a total of 11 rivers in Scotland have lost their freshwater pearl mussel populations. This represents a slowing in the extinction rate prior to 1999 (the rate of river exinctions in Scotland has more than halved since 1999), and all the extinct populations were those that were previously non-recruiting and dominated by adults.
5.11 Change and reason for change in surface area of range	There has been a decrease in the number of sites due to extinction in some rivers. But also some new sites have been recorded and application of sub aqua methods have improved knowledge in other sites. Overall, the results may suggest that some parameters such as range are increasing (by finding previously unknown sites), but several known populations have been lost and therefore the number of sites, and the species range in NE Scotland in particular is decreasing
5.12 Additional information	There have been an important number of new populations recorded within the last 6 years in Scotland. However a number of important populations have become extinct, notably populations in Aberdeenshire and Moray, that mean the specie's range of extant populations in NE Scotland has contracted.
5.12 Additional information	An important development during the current reporting cycle has been the discovery that different pearl mussel populations use different host salmonid species. This can have important implications for the conservation measures implemented at some sites.
6.4 Additional population size	The number of colonies refers, as in previous reports, to the number of viable populations (note - there are further non-viable populations)
7.1 Sufficiency of area and quality of occupied habitat	The freshwater pearl mussel burrows into sand and gravel substrates, often between larger boulders and cobbles, in fast-flowing rivers and streams. It requires cool, well oxygenated soft water, free of pollution and very low in turbidity. The pearl mussels spends its larval, or glochidial, stage attached to the gills of salmonid fish. The quality of habitat is therefore vital to conserving freshwater pearl mussel populations and improving the condition of some habitat would help restore some populations so they would become viable, and help increase the species' range. A lack of rivers (per se as wetted channels) is not a reason for the sufficiency of habitat, it is the quality of river habitat that is important.
7.4 Short term trend; Direction	This has been judged to be 'uncertain'. There is no quantitative habitat trend data for this species since the last reporting round. There have been some notable successes in the last reporting round with the condition of some Special Areas of Conservation improving due to improvements in habitat quality via the restoration of natural processes. However there have been some SACs where condition has deteriorated and some populations in the wider countryside that have been lost altogether. In many of those instances this is a result of poor habitat quality such as water quality, riparian and instream habitat and host fish populations. Given the improving condition of habitat is some SACs, and the apparently deteriorating picture (particularly) in some populations outside protected areas then the short term habitat trend is uncertain.

7.7 Long term trend; Direction	In the longer term, since late last century, the overall trend for the species is decreasing. Although there in no quantitive habitat trend data, the national survey of Scotland that took place during the last reporting cycle reported that several populations (which had last been surveyed in approx 1999-2000) had become extinct. And, in many cases, this was due to habitat quality. It is important to note that freshwater pearl mussels are extermely sensitive to changes in some habitat determinands (e.g. nutrients, organic pollution, fine sediment). Such determinands are controlled and regulated and, although the implementation of the Water Framework Directive has helped to improve the ecological status of many waterbodies in Scotland, it is considered that the habitat requirements of the freshwater pearl mussel are so high that much of the restorative action required under the WFD objectives (e.g. good ecological status) are insufficient to restore the habitat such that freshwater pearl mussels will become viable. For this species, this remains an important policy gap. Further, many of the pressures on the habitat quality of pearl mussels are diffuse or long-term (such as diffuse pollution, morphological quality of rivers) which in large catchments can have considerable lead-in times before benefits are realised.
9.5 List of main conservation measures	There has been considerable investment to improve the conservation of freshwater pearl mussels over the reporting period. Within SACs the Pearls in Peril project has been successfully completed and reduced diffuse pollution from forestry and agriculture, established multiple riparian woodlands, contributed to action to reduce wildlife crime, reinforced vulnerable populations and restored instream habitat. Beyond the end of that project, conservation work continues via catchment management groups and the Dee/Don riparian enhancement project, Peatland ACTION and other conservation efforts such as a community initiative in Ardnamurchan. Research outputs, describing different host preferences in different catchments is also helping to inform conservation actions, as well as leading to further research on the genetic structuring of pearl mussel populations. Measures to address and control fine sediment management are a particular priority and the success of such projects is demonstrated by the work over more than a decade by Forest Enterprise Scotland, the Argyll Fisheries Trust and SNH that has led to the first SAC moving into favourable condition due to management interventions. The first time we are aware that this has happened in the UK, or elsewhere, in recent years. There were some conservation measures it was difficult to brigade into the available choices. For example, an important priority at present is to establish riparian woodlands along some watercourses (to improve habitat and provide shade), as well as restore riparian wetlands to improve flow management, and restore instream habitat damaged by river engineering in the past. There was no obvious home for such measures to be explicitly referenced in the conservation measures section and so I have included them in CL04: Other measures related to natural processes.

10.1 Future prospects of parameters	The current range of the freshwater pearl mussels in Scotland is extensive, ranging between populations in Galloway and Ayrshire in the south to a population in the Northern Isles. And also between the Outer Hebrides in the west to large east coast rivers draining into the North Sea. At the extreme ends of this range, some populations are continuing to decline and close to extinction despite concerted conservation action (from pressures ranging from habitat quality to wildlife crime). To date, conservation action has been prioritised to populations within Special Areas of Conservation and the range of those populations is largely stable at present. However in some very small populations outside of SACs, only a small number of old, adult mussels remain in catchments that have significant land use pressures which, while the habitat quality may be gradually improving, will not reach sufficiently high quality to support successfully recruiting pearl mussel populations in the near future. The future prospect for populations is also poor. This is also because some relatively small, remenant populations are still likely to be lost and, in a small number of larger populations, the distribution of the populations is also contracting within these rivers. In some instances the reasons for the reduced distribution is unclear (despite research effort) and in other instances it can be due to pressure from habitat quality, wildlife crime, and/or the status of host fish populations. It is important to note that there have been efforts to increase the range and population of freshwater pearl mussels in Scotland through re-introductions. There have been three to date and recent evidence suggests that two of those have been successful. Efforts to continue investigating and taking action to increase distribution within key rivers is also underway, particularly on the River Spey with the intention of restoring pearl mussels into the upper catchment. The future prospects for habitat quality are slightly negative. There is very considerable investment underway in Scotland, and has been for many years, to improve habitat quality in our rivers. Over the last decade much of this investment has been driven by the implementation of the Water Framework Directive. While that is leading to improved habitat quality, the improvements in many places may not lead to sufficiently high quality habitat to support recruiting pearl mussel populations (given their very demanding habitat requirements). Therefore, there will likely still be a deterioration in the range and population of freshwater pearl mussels while habitat quality overall does not decline as much.
12.1 Population size inside the pSCIs, SCIs and SACs network	There has been considerable investment in conservation measures within the SAC network in Scotland during the last reporting cycle - particularly the Pearls in Peril project. This has resulted in the first SAC for the species being moved into 'unfavourable recovering' category as a direct result of the implementation of conservation measures. For such a delicate and long-lived indicator species as freshwater pearl mussels this is considered a major and considerable achievement showing that conservation measures can be effective.
12.4 Short term trend of the population size within the network; Direction	The assessment that this is decreasing is due to a (relatively small) contraction in the number of occupied grid squares in two SACs following the most recent surveys in 2014/15. In two large SACs the furthest point at which upstream pearl mussels were recorded had receded slightly meaning that distribution in the sites was slightly more restricted than in previous surveys. However, it should be noted that it is intended that this is a short term future trend as actions are underway to investigate the reasons for this apparent contraction and to reverse the trend.