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*)

ENGLAND

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 (England 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	2007-2018
2.3 Distribution map	Yes
2.4 Distribution map Method used	Complete survey or a statistically robust estimate
2.5 Additional maps	No

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

3.1 Is the species taken in the wild/exploited?	Yes	
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	Yes
	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	Yes
	f) regulation of the purchase, sale, offering for sale, keeping for sale or transport for sale of specimens	Yes
	g) breeding in captivity of animal species as well as artificial propagation of plant species	Yes
	h) other measures	Yes

Translocation protocol produced for the movement of mussels for conservation purposes. Killeen, I. & Moorkens, E., 2016.

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

a) Unit

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

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

3.5. Additional information

BIOGEOGRAPHICAL LEVEL

4. Biogeographical and marine regions

4.1 Biogeographical or marine region where the species occurs

Atlantic (ATL)

4.2 Sources of information

NATURAL ENGLAND, 2014. Planning for the Future Improvement Programme for England's Natura 2000 Sites (IPENS). Site Improvement Plan: River Clun SAC UK0030250. http://publications.naturalengland.org.uk/publication/6216527934128128?category=4879822899642368
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E3 ECOLOGY LTD, 2016. Freshwater pearl mussel survey River North Tyne tributaries, November 2016. Report to Natural England.
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current and potential habitat in the River Esk, Yorkshire. Malacological Services. Report to North York Moors National Park Authority.
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O'LEARY, D., 2016. Pearls in Peril Project. Action A3: Conservation Actions for the Freshwater Pearl Mussel in the River Ehen, Cumbria, September 2013-2016. LIFE + 11 NAT UK 000383: PIP GB. West Cumbria Rivers Trust.
O'LEARY, D., 2017. River Ehen: Freshwater mussel survey for Ennerdale Mill Weir, July 2017. West Cumbria Rivers Trust.
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KILLEEN, I. & MOORKENS, E., 2015. River Ehen freshwater mussel habitat mapping. Results of pilot study carried out in September 2014. Report to United Utilities - March 2015.
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E3 ECOLOGY LTD, 2018. Freshwater pearl mussel survey: River North Tyne, July 2018. Report to Environment Agency.

5. Range

5.1 Surface area (km²)		
5.2 Short-term trend Period	2007-2018	
5.3 Short-term trend Direction	Unknown (x)	
5.4 Short-term trend Magnitude	a) Minimum	b) Maximum
5.5 Short-term trend Method used	Complete survey or a statistically robust estimate	
5.6 Long-term trend Period		
5.7 Long-term trend Direction		
5.8 Long-term trend Magnitude	a) Minimum	b) Maximum
5.9 Long-term trend Method used		
5.10 Favourable reference range	a) Area (km²) b) Operator c) Unknown d) Method	
5.11 Change and reason for change in surface area of range	No change	

	The change is mainly due to:	
5.12 Additional information		

6. Population

6.1 Year or period	2007-2018	
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	143
6.3 Type of estimate	Best estimate	
6.4 Additional population size (using population unit other than reporting unit)	a) Unit	number of localities (localities)
	b) Minimum	
	c) Maximum	
	d) Best single value	1
6.5 Type of estimate	Best estimate	
6.6 Population size Method used	Complete survey or a statistically robust estimate	
6.7 Short-term trend Period	2007-2018	
6.8 Short-term trend Direction	Decreasing (-)	
6.9 Short-term trend Magnitude	a) Minimum	
	b) Maximum	
	c) Confidence interval	
6.10 Short-term trend Method used	Complete survey or a statistically robust estimate	
6.11 Long-term trend Period		
6.12 Long-term trend Direction		
6.13 Long-term trend Magnitude	a) Minimum	
	b) Maximum	
	c) Confidence interval	
6.14 Long-term trend Method used		
6.15 Favourable reference population (using the unit in 6.2 or 6.4)	a) Population size	
	b) Operator	
	c) Unknown	
	d) Method	
6.16 Change and reason for change in population size	Genuine change	
	The change is mainly due to:	Genuine change
6.17 Additional information		

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7. Habitat for the species

7.1 Sufficiency of area and quality of occupied habitat	a) Are area and quality of occupied habitat sufficient (to maintain the species at FCS)?	No
	b) Is there a sufficiently large area of occupied AND unoccupied habitat of suitable quality (to maintain the species at FCS)?	Unknown
7.2 Sufficiency of area and quality of occupied habitat Method used	Based mainly on extrapolation from a limited amount of data	
7.3 Short-term trend Period	2007-2018	
7.4 Short-term trend Direction	Unknown (x)	
7.5 Short-term trend Method used	Based mainly on extrapolation from a limited amount of data	
7.6 Long-term trend Period		
7.7 Long-term trend Direction		
7.8 Long-term trend Method used		
7.9 Additional information		

8. Main pressures and threats

8.1 Characterisation of pressures/threats

Pressure	Ranking
Conversion from one type of agricultural land use to another (excluding drainage and burning) (A02)	H
Intensive grazing or overgrazing by livestock (A09)	H
Application of synthetic (mineral) fertilisers on agricultural land (A20)	H
Forestry activities generating pollution to surface or ground waters (B23)	M
Pollution to surface or ground water due to urban run-offs (F11)	M
Modification of flooding regimes, flood protection for residential or recreational development (F28)	M
Abstraction of ground and surface waters (including marine) for public water supply and recreational use (F33)	H
Other invasive alien species (other then species of Union concern) (I02)	M
Decline or extinction of related species (e.g. food source / prey, predator / parasite, symbiote, etc.) due to climate change (N07)	M

Threat	Ranking
Conversion from one type of agricultural land use to another (excluding drainage and burning) (A02)	H
Intensive grazing or overgrazing by livestock (A09)	H
Application of synthetic (mineral) fertilisers on agricultural land (A20)	H

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Forestry activities generating pollution to surface or ground waters (B23)	M
Pollution to surface or ground water due to urban run-offs (F11)	M
Modification of flooding regimes, flood protection for residential or recreational development (F28)	M
Other invasive alien species (other then species of Union concern) (I02)	M
Decline or extinction of related species (e.g. food source / prey, predator / parasite, symbiote, etc.) due to climate change (N07)	M
Other climate related changes in abiotic conditions (N09)	M
Reduced fecundity / genetic depression (e.g. inbreeding or endogamy) (L05)	H

8.2 Sources of information	All rivers All rivers All rivers All rivers All rivers All rivers North Tyne - Kielder Reservoir River Ehen - water abstraction being addressed through compensation measures with United Utilities (abstraction to stop by 2022). All rivers All rivers All rivers All rivers
8.3 Additional information	Conversion of grassland to other agricultural land (e.g arable) leading to increased agricultural siltation. A major issue affecting FWPM habitat is silt entering the watercourse and covering the bed; silt can block the interstitial substrate and prevent the essential oxygen transfer affecting juvenile mussel survival, silt can smother salmon spawning habitat and can provide a suitable substrate for macrophytes to become established. Diffuse pollution - Agricultural. Stock using the river as a source of drinking water track mud and silt into the water and also de-stabilise river banks causing erosion. Farm tracks and stock feeders for overwintering livestock are also a source of silt. Diffuse pollution - Agricultural. Nutrient enrichment (e.g. fertiliser run-off, animal excrement at watering areas) increases the potential for algal growth and reduction of interstitial oxygen. Diffuse pollution - Forestry. Forestry operations have the potential to result in siltation, nutrient enrichment and acidification of the watercourse if not managed in the appropriate way. Diffuse - Urban run off; Point - Storm overflows. Run-off into rivers from the local road network will carry pollutants such as oils and fuels in addition to silt into the watercourse to the detriment of the river. A combined sewer overflow (CSO) is the discharge of wastewater and storm water from a combined sewer system directly into a river. Risk to FWPM habitat if operating frequently and introducing raw untreated waste and sewage litter. Morphology - physical modification. The morphology of the river determines

the rate of sediment transport through the channel, and erodability of the river bed and banks. All of which can affect the FWPM habitat. Rivers have been artificially widened and straightened and also have weirs that affect the natural flow and sediment transfer regime of the river. There are areas of hard revetment to stabilise the river bank in various states.
Abstraction or flow diversion - Public water supply. Abstraction affects natural flow of a river system. It has been determined that flow regulation can have negative effects on FWPM. Prolonged low flows can cause stress due to temperature increase, oxygen depletion, concentrated pollutants and reduction of silt transport.
Introduced species and diseases. There is a threat to FWPM habitat from dense monocultures of plants such as Himalayan balsam and Japanese knotweed. When these species die down in winter, they leave the river banks bare, exposing them to increased soil erosion which affects FWPM habitat as well as potential to affect the oxygen levels in the river if they decay in the river. The spread of tree diseases such as Phytophora and Ash Chalara will lead to further losses of riparaian trees that protect banks from erosion and also providing essential shade that keeps water cool.
Pressures may also be those that are leading to reduced numbers of juvenile salmon and/or trout in some pearl mussel streams (e.g. poor marine survival, aquaculture F01.01). Salmonids are essential to the lifecycle of FWPM. The health and number of host fish to support the lifecycle is essential.
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.
The majority of FPM populations in England have declined significantly and now consist of isolated populations with low numbers of adults mussels with no recent recruitment . A number of populations are now on the verge of extinction.

9. Conservation measures

9.1 Status of measures	a) Are measures needed?	Yes
	b) Indicate the status of measures	Measures identified and taken
9.2 Main purpose of the measures taken		Maintain the current range, population and/or habitat for the species
9.3 Location of the measures taken		Both inside and outside Natura 2000
9.4 Response to the measures		Long-term results (after 2030)
9.5 List of main conservation measures		

Manage water abstraction for public supply and for industrial and commercial use (CF11)

Management, control or eradication of other invasive alien species (CI03)

Reinforce populations of species from the directives (CS01)

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Reduce/eliminate point source pollution to surface or ground waters from industrial, commercial, residential and recreational areas and activities (CF04)
Reduce diffuse pollution to surface or ground waters from agricultural activities (CA11)
Manage the use of natural fertilisers and chemicals in agricultural (plant and animal) production (CA09)
Reduce diffuse pollution to surface or ground waters from forestry activities (CB10)
Prevent conversion of natural and semi-natural habitats, and habitats of species into agricultural land (CA01)
Manage changes in hydrological and coastal systems and regimes for construction and development (CF10)

9.6 Additional information

10. Future prospects

10.1 Future prospects of parameters

a) Range

b) Population

c) Habitat of the species

10.2 Additional information

11. Conclusions

11.1. Range

11.2. Population

11.3. Habitat for the species

11.4. Future prospects

11.5 Overall assessment of Conservation Status

11.6 Overall trend in Conservation Status

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

a) Overall assessment of conservation status

No change

The change is mainly due to:

b) Overall trend in conservation status

No change

The change is mainly due to:

11.8 Additional information

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

12.1 Population size inside the pSCIs, SCIs and SACs network (on the biogeographical/marine level including all sites where the species is present)

a) Unit	number of map 1x1 km grid cells (grids1x1)
b) Minimum	
c) Maximum	
d) Best single value	21

12.2 Type of estimate

Best estimate

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12.3 Population size inside the network Method used	Complete survey or a statistically robust estimate
12.4 Short-term trend of population size within the network Direction	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	The only trans-boundary population is the River Wye which flows from Wales into England. Historically, the Wye has supported a large mussel population in the 1970s. The river was last survyed between 1992-1994. Eighty sites were investigated but only six contained mussels and a total of only 21 individuals were found (four in England, 17 in Wales). Without any recent records, it is likely that the population has been lost in the England sections of the Wye.
13.3 Other relevant Information	

Distribution Map

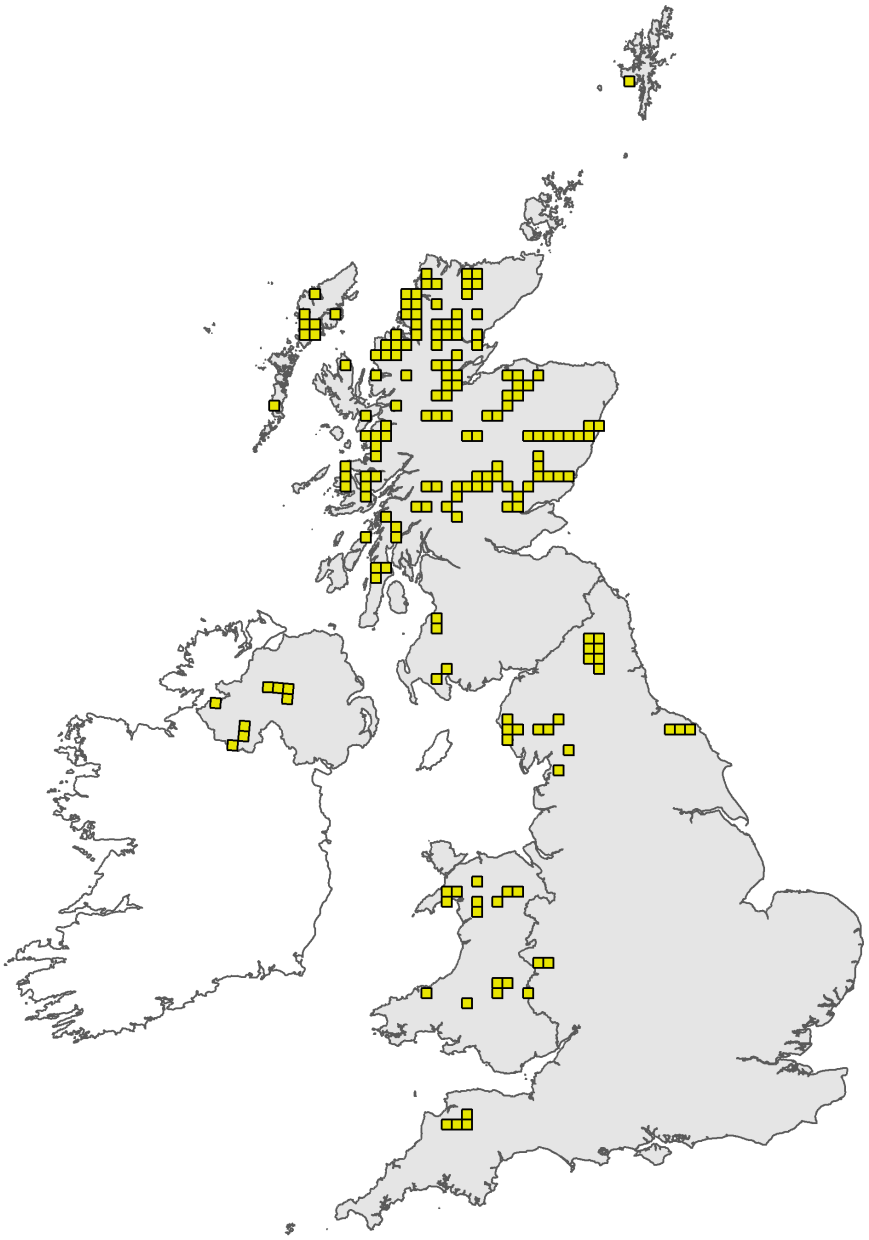

Figure 1: UK distribution map for S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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

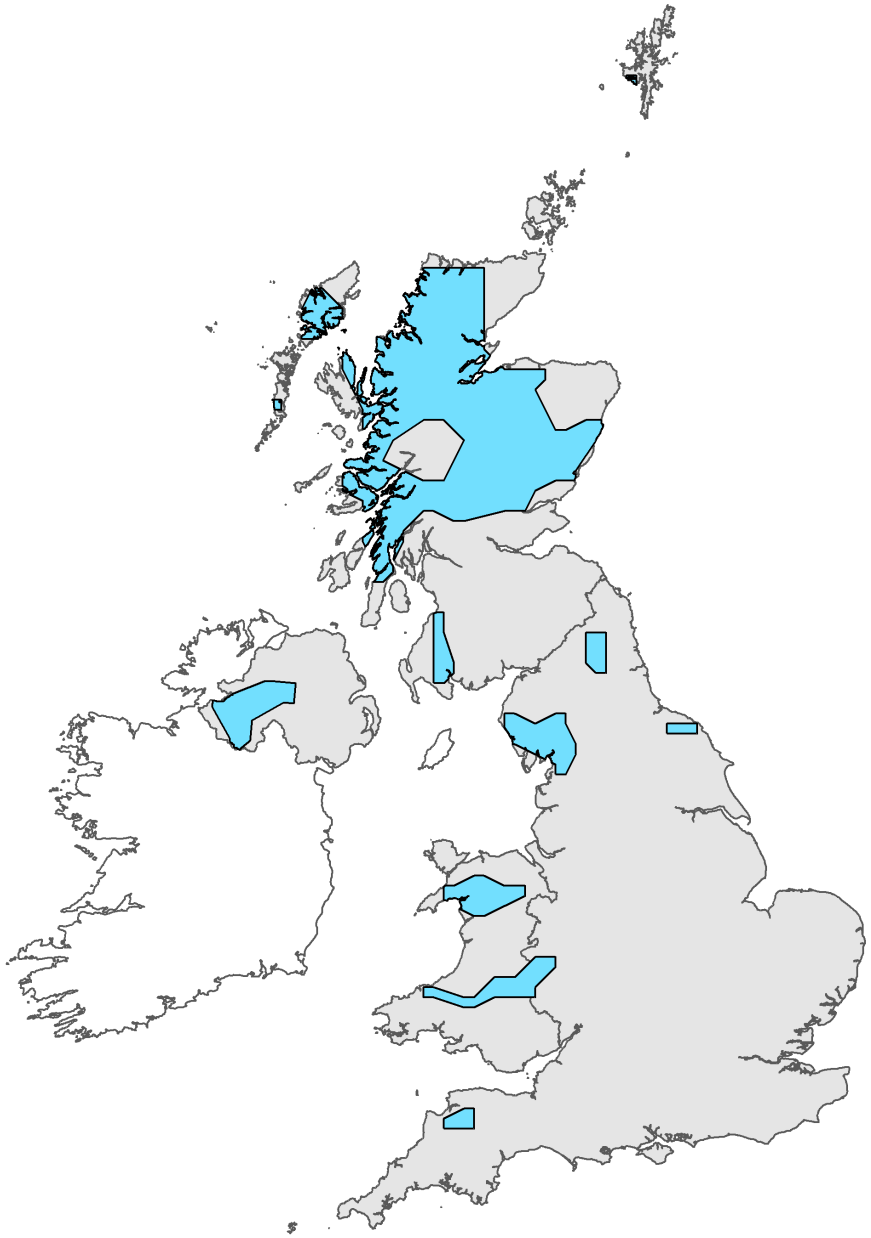

Figure 2: UK range map for S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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)

Field label	Note
2.3 Distribution map	Populations of the freshwater pearl mussel are now found across rivers in northern England with outlying populations in Shropshire and Devon. The range map shows the current known distribution for the period 2007-2018. A number of populations have not been survyed since 2006 and the range map is based on the lastest full baseline survey available for each population.
3.2 Which of the measures in Art. 14 have been taken?	The freshwater pearl mussel is fully protected under the Wildlife and Countryside Act 1981 (as amended) and it is an offence to disturb, take, injure, kill or to sale pearls. Under the Act, Wildlife Licences are available to allow activities that would otherwise be an offence, including: for scientific or educational purposes; for the purposes of ringing or marking and for conserving wild animals or introducing them into a particular area. Over the reporting period (2007-2018), conservation efforts in England have focussed on captive breeding of threatened populations. Adults mussels have been translocated to secure hatchery facilities. We are now in the position of introducing juvenile mussels for some populations back to their native rivers. Historically, illegal pearl fishing has had a direct impact on populations in England which led to loss of some populations 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. FPM is a Wildlife Crime Priority in the UK (http://www.nwcu.police.uk/how-do-we-prioritise/).

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

Field label	Note
5.11 Change and reason for change in surface area of range	The overall range in England has not changed since the previous reporting period (2007-2012). However, the species continues to be lost from areas of suitable habitat within existing rivers due to general habitat degradation (e.g. siltation, water quality and flows). There is no recent recruitment to the majority of populations to replace losses of adult mussels. The short-term range trend is assesed as unknown. A number of distribution surveys have been undertaken during the reporting period to make the assessment.
6.2 Population size	For the period 2007-2018 it is estimated that there are 143 occupied 1km squares. This is based on available survey data undertaken during this period. For details on methodology see UK's approach for estimating population (including Favourable Reference Population) using 1km square resolution records data (Interagency feshwater group 2018).
6.4 Additional population size	Only one river in England is classed as having a natural, self-sustaining population (i.e. juvenile recruitment) for the reporting period 2013-2018. There has been no change in the population unit for England and the value outlined in the 2007 report has been used (i.e. no. of rivers supporting viable pops.). The standard technique for freshwater pearl mussel survey includes quantitative assessment based on transect counts. These also entail searching for the presence of juvenile mussels as a sign of recent recruitment and population viability.
6.8 Short term trend; Direction	Detailed survey work over the last the two reporting periods (2007-2018) have shown a particularly dramatic decline in FPM populations in England. There are now only two rivers with significant populations (>10,000 individuals) and two rivers with populations > 1,000 individuals. Most populations comprise large adults with no evidence of juvenile recruitment for at least 30 years.

6.16 Change and reason for change in population size	The species continues to be lost from areas of suitable habitat within existing rivers due to general habitat degradation (e.g. siltation, water quality and flows). There is no recent recruitment in the majority of populations to replace losses of adult mussels. The short-term range trend is assesed as declining. A number of distribution surveys have been undertaken during the reporting period to make the assessment.
6.17 Additional information	6.18 Age structure, mortality and reproduction. Only one river in England has a natural, self-sustaining population with adequate juvenile recruitment. All other populations have old aged adult mussels with no juvennile recruitment within the last 25 years. Overall, populations are deviating from a normal age structure for a healthy population.
7.1 Sufficiency of area and quality of occupied habitat	(7.1 a) Is area/quality of occupied habitat sufficient (to maintain the species at FCS)? Area - Yes; Quality - No. Final conclusion - No. (7.1 b) Is area/quality of occupied and unoccupied habitat sufficient (to maintain the species at FCS)? Area - unknown; Quality - unknown. Final conclusion - unknown. The short-term trend (2007-2018) is classed as unknown - area of habitat has not changed.
7.2 Sufficiency of area and quality of occupied habitat; Method used	Field work has been undertaken from 2014 - 2017 to to determine the extent of current and potential habitat for juvenile freshwater mussels in the River Ehen SAC. This is intended to provide a baseline that alongside routine monitoring will help ensure that ongoing and planned restoration works will be sucessful in bringing the SAC to favourable condition. Initial results for the main sections supporting FPM population show that 29% has good juvenile habitat and a further 26% has potential juvenile habitat. Out of the total area of riverbed in the upstream sections (33,000m2), it is estimated that c.18,000m2 could support juvenile mussels (Killeen and Moorkens (2018) in prep).
8.1 Characterisation of pressures/ threats	FPM declines in England are attributed to: 1. 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 fishery management); 2. increased disturbance aided by improved accessibility; 3. spread of invasive non-native species and tree diseases (e.g. Himalyan balsam and Phytophora) impacting on riparian and in-channal habitat and 4. fishery management practices such as re-stocking and a decline in the numbers of host fish (salmon/trout).
8.3 Additional information	The threats are essentially the same as the pressures listed. The additional ones are changes in abiotoc 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. 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.
9.5 List of main conservation measures	The identifed conservation measures are aimed to address the main listed pressures inorder to maintain the current mussel range / populations in England. Urgent action is needed to address the threat of extinction faced by some populations in the short term and, whilst improving water quality and catchment land use is a long-term commitment, ensuring that genetic material is available to restock rivers in the future is a top priority. This will buy time for pearl mussel populations while we continue to improve river catchments in order to create the right conditions to sustain pearl mussel populations.

10.1 Future prospects of parameters	Habitat: The species will continue to be lost from areas of suitable habitat within existing rivers due to general habitat degradation. It is expected that conservation measures over the next twelve years will slow the rate of decline and see further improvements in water quality and habitat for the species (at a local level). Overall habitat for species is assessed as positive - slight/moderate improvement. Population: A number of populations are at risk of extinction over the next two reporting periods due to remaining low numbers and no juvenile recruitment. Conservation efforts are looking to address this for a number of populations through captive breeding/reintroduction but the outcome of these measures will be long-term (beyond 2030). Overall population is assessed as negative deterioating. Range: For a long-lived species the overall range in England is not expected to change greatly over the next twelve years. However, this masks a continuing decline at a local level with a contraction within-river range and with no juvenile recruitment to replace adult losses. This will be counteracted through moderate improvments in water/habitat quality and conservation efforts (e.g. reintroductions through cative breeding). Overall, the range is assessed as unknown due to uncertainties of the outcomes of listed conservation measures.
12.4 Short term trend of the population size within the network; Direction	The 2007-2018 trend is classed a declining as there has been a clear decline in the conservation status in 3 out of the 4 N2K sites. One population is almost extinct with very few remaining adults and two populations are dying out with remaining adults now confined to short sections with no juvenile recruitment. Only one population is classed as viable with large numbers of adults and with recent recruitment of juvenile mussels.
12.6 Additional information	The N2K network currently supports four populations for the species in England. A further two N2K site (River Wye, River Derwent), it is presumed the populations has been lost with no recent records from the last 25 years. The majority of the English population is found within the N2K network, (with one river holding 90% of the English total). The data quality is relatively good, with nearly all of the SACs having been surveyed in the reporting time period. Where trend data exists, this shows that in some populations there has been a clear decline in conservation status during the time period. There has been no reduction in the number of viable populations (1 population), however some populations have lost a considerable proportion of their populations over the reporting period (>90% in one case).