Report under The Conservation of Habitats and Species Regulations 2017 (as amended), Regulation 9A

2019-2024

Conservation status assessment for the species:

S1029 - Freshwater pearl mussel

(*Margaritifera margaritifera*)

Wales

Cyfoeth Naturiol Cymru
Natural Resources Wales

JNCC

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Important note - Please read

- The information in this document represents the Wales Report under The Conservation of Habitats and Species Regulations 2017 (as amended), Regulation 9A, for the period 2019-2024.
- It is based on supporting information provided by Natural Resources Wales, which is documented separately.
- The Habitats Regulations reporting 2019-2024 Approach Document provides details on how this supporting information contributed to the UK Report and the fields that were completed for each parameter.
- Maps showing the distribution and range of the species are included.
- Explanatory notes (where provided) are included at the end. These provide additional audit trail information to that included within the assessments. Further underpinning explanatory notes are available in the related country reports.
- Some of the reporting fields have been left blank because either: (i) there was insufficient information to complete the field; (ii) completion of the field was not obligatory; and/or (iii) the field was not relevant to this species (section 12 National Site Network coverage for Annex II species).

Further details on the approach to the Habitats Regulations Reporting 2019-2024 are available on the JNCC website.

Assessment Summary: Freshwater pearl mussel

Distribution Map

Range Map

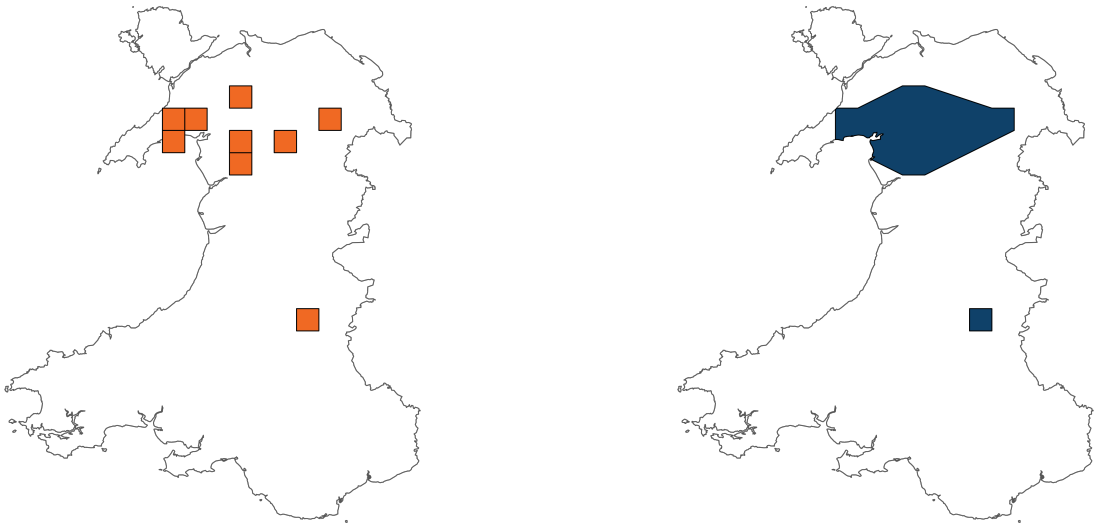

Figure 1: Wales distribution and range map for S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority. The 10km grid square distribution map is based on available species records within the current reporting period.

Table 1: Table summarising the conservation status for S1029 - Freshwater pearl mussel (*Margaritifera margaritifera*). Overall conservation status for species is based on assessments of range, population, habitat for the species, and future prospects.

Overall Conservation Status (see section 11)

Unfavourable-bad (U2)

Breakdown of Overall Conservation Status

Range (see section 5)	**Unfavourable-bad (U2)**
Population (see section 6)	**Unfavourable-bad (U2)**
Habitat for the species (see section 7)	**Unfavourable-bad (U2)**
Future prospects (see section 10)	**Unfavourable-bad (U2)**

List of Sections

National Level

1. General information

1.1 Country	Wales
1.2 Species code	S1029
1.3 Species scientific name	*Margaritifera margaritifera*
1.4 Alternative species scientific name	
1.5 Common name	Freshwater pearl mussel
Annex(es)	II, V

2. Maps

2.1 Sensitive species	Yes
2.2 Year or period	2007-2024
2.3 Distribution map	Yes
2.4 Distribution map; Method used	Complete survey or a statistically robust estimate

2.5 Additional information

No additional information

3. Information related to Annex V Species

3.1 Is the species taken in the wild / exploited?	No

3.2 What measures have been taken?

a) Regulations regarding access to property	No
b) Temporary or local prohibition on the taking of specimens in the wild and exploitation	Yes
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	Yes
Other measures	No
Other measures description	

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

a) Unit No unit - not reported

Table 2: Quantity taken from the wild during the reporting period (see 3.3a for units). For species with defined hunting seasons, Season 1 refers to 2018/2019 (autumn 2018 to spring 2019), and Season 6 to 2023/2024. For species without hunting seasons, data are reported by calendar year: Year 1 is 2019, and Year 6 is 2024.

	Season/ year 1	Season/ year 2	Season/ year 3	Season/ year 4	Season/ year 5	Season/ year 6
b) Minimum	-	-	-	-	-	-
c) Maximum	-	-	-	-	-	-
d) Unknown	No	No	No	No	No	No

3.4: Hunting bag or quantity taken in the wild; Method used

3.5: Additional information

No additional information

Biogeographical Level

4. Biogeographical and marine regions

4.1 Biogeographical or marine region where the species occurs ATL

4.2 Sources of information

See section 14 References

5. Range

5.1 Surface area (km²)	2,114.01
5.2 Short-term trend; Period	2018-2024
5.3 Short-term trend; Direction	Decreasing
5.4 Short-term trend; Magnitude	
a) Estimated minimum	
b) Estimated maximum	
c) Pre-defined range	Decreasing 26 - 50%
d) Unknown	No
e) Type of estimate	
f) Rate of decrease	Decreasing >1% (more than one percent) per year on average
5.5 Short-term trend; Method used	Complete survey or a statistically robust estimate
5.6 Long-term trend; Period	1980-2024
5.7 Long-term trend; Direction	Decreasing
5.8 Long-term trend; Magnitude	
a) Minimum	23
b) Maximum	23
c) Rate of decrease	

	Decreasing >1% (more than one percent) per year on average
5.9 Long-term trend; Method used	Complete survey or a statistically robust estimate

5.10 Favourable Reference Range (FRR)

a) Area (km²)	
b) Pre-defined increment	Current range is between 51% and 100% smaller than the FRR
c) Unknown	No
d) Method used	Reference-based approach
e) Quality of information	high

5.11 Change and reason for change in surface area of range

a) Change	Yes
b) Genuine change	Yes
c) Improved knowledge or more accurate data	No
d) Different method	No
e) No information	No
f) Other reason	No
g) Main reason	Genuine change

5.12 Additional information

No additional information

6. Population

6.1 Year or period	2013-2024

6.2 Population size (in reporting unit)

a) Unit	number of map 1x1 km grid cells

b) Minimum	
c) Maximum	
d) Best single value	59
6.3 Type of estimate	Best estimate
6.4 Quality of extrapolation to reporting unit	

6.5 Additional population size (using population unit other than reporting unit)

a) Unit	No unit - not reported
b) Minimum	
c) Maximum	
d) Best single value	
e) Type of estimate	
6.6 Population size; Method used	Complete survey or a statistically robust estimate
6.7 Short-term trend; Period	2013-2024
6.8 Short-term trend; Direction	Decreasing
6.9 Short-term trend; Magnitude	
a) Estimated minimum	
b) Estimated maximum	
c) Pre-defined range	Decreasing 13 - 25%
d) Unknown	No
e) Type of estimate	Pre-defined range
f) Rate of decrease	Decreasing >1% (more than one percent) per year on average
6.10 Short-term trend; Method used	Based mainly on extrapolation from a limited amount of data
6.11 Long-term trend; Period	1989-2024

6.12 Long-term trend; Direction	Decreasing
6.13 Long-term trend; Magnitude	
a) Minimum	
b) Maximum	
c) Confidence interval	
d) Rate of decrease	Decreasing >1% (more than one percent) per year on average
6.14 Long-term trend; Method used	Complete survey or a statistically robust estimate

6.15 Favourable Reference Population (FRP)

ai) Population size	
aii) Unit	
b) Pre-defined increment	Current population is between 51% and 100% smaller than the FRP
c) Unknown	No
d) Method used	Reference-based approach
e) Quality of information	high

6.16 Change and reason for change in population size

a) Change	Yes
b) Genuine change	Yes
c) Improved knowledge or more accurate data	Yes
d) Different method	No
e) No information	No
f) Other reason	No
g) Main reason	Genuine change

6.17 Additional information

No additional information

6.18 Age structure, mortality and reproduction deviation	Yes, strongly deviating from normal

7. Habitat for the species

7.1 Sufficiency of area and quality of occupied habitat (for long-term survival)

a) Is area of occupied habitat sufficient?	No
b) Is quality of occupied habitat sufficient?	No
c) If No or Unknown, is there a sufficiently large area of unoccupied habitat of suitable quality?	No

7.2 Sufficiency of area and quality of occupied habitat; Method used

a) Sufficiency of area of occupied habitat; Method used	Based mainly on extrapolation from a limited amount of data
b) Sufficiency of quality of occupied habitat; Method used	Based mainly on extrapolation from a limited amount of data

7.3 Short-term trend; Period	2013-2024
7.4 Short-term trend; Direction	Unknown
7.5 Short-term trend; Method used	Insufficient or no data available

7.6 Long-term trend; Period	1990-2024
7.7 Long-term trend; Direction	Decreasing
7.8 Long-term trend; Method used	Based mainly on expert opinion with very limited data

7.9 Additional information

No additional information

8. Main pressures

8.1 Characterisation of pressures

Table 3: Pressures affecting the species, including timing and importance/impact ranking. Pressures are defined as factors acting currently and/or during the reporting period (2019–2024). Rankings are: High (direct/immediate influence and/or large spatial extent) and Medium (moderate direct/immediate influence, mainly indirect and/or regional extent).

Pressure	Timing	Ranking
PA17: Agricultural activities generating pollution to surface or ground waters (including marine)	Ongoing and likely to be in the future	High (H)
PA21: Active abstraction of water for agriculture	Ongoing and likely to be in the future	Medium (M)
PB23: Physical alteration of water bodies for forestry (including dams)	Ongoing and likely to be in the future	Medium (M)
PD02: Hydropower (dams, weirs, run-off-the-river and respective infrastructure)	Ongoing and likely to be in the future	Medium (M)
PK01: Mixed source pollution to surface and ground waters (limnic and terrestrial)	Ongoing and likely to be in the future	High (H)
PL05: Modification of hydrological flow (mixed or unknown drivers)	Ongoing and likely to be in the future	Medium (M)
PJ03: Changes in precipitation regimes due to climate change	Ongoing and likely to be in the future	Medium (M)
PM02: Flooding	Ongoing and likely to be in the future	Medium (M)
PL02: Drainage (mixed or unknown drivers)	Ongoing and likely to be in the future	High (H)
PL06: Physical alteration of water bodies (mixed or unknown drivers)	Ongoing and likely to be in the future	High (H)
PJ10: Change of habitat location, size, and / or quality due to climate change	Ongoing and likely to be in the future	High (H)

8.2 Sources of information

See section 14 References

8.3 Additional information

No 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	Increase the population size and/or improve population dynamics (related to 'Population')
9.3 Location of the measures taken	Both inside and outside National Site Network
9.4 Response to measures	Medium-term results (within the next two reporting periods, 2025–2036)

9.5 List of main conservation measures

Table 4: Key conservation measures addressing current pressures and/or anticipated threats during the next two reporting periods (2025–2036). Measures are ranked by importance/impact: High (direct/immediate influence and/or large spatial extent) and Medium (moderate direct/immediate influence, mainly indirect and/or regional extent).

Conservation measure	Ranking
MA10: Reduce/eliminate point or diffuse source pollution to surface or ground waters (including marine) from agricultural activities	Medium (M)
MA13: Manage agricultural drainage and water abstraction (incl. the restoration of drained or hydrologically altered habitats)	Medium (M)
MB10: Reduce diffuse or point source pollution to surface or ground waters (incl. marine) from forestry activities	Medium (M)
MB14: Manage drainage and water abstraction for forestry (inc. restoration of drained or hydrologically altered habitats)	Medium (M)
MC04: Reduce impact of hydropower operation and infrastructure (incl. the restoration of freshwater habitats)	Medium (M)
MJ02: Implement climate change adaptation measures	Medium (M)
MK01: Reduce impact of mixed source pollution	High (H)
MK03: Restoration of habitats impacted by multi-purpose hydrological changes	High (H)

MK04: Other measures related to mixed source pollution.	Medium (M)
MS01: Reinforce populations of species from the directives	High (H)
MS02: Reintroduce species from the directives	High (H)
MS03: Restoration of habitat of species from the directives	High (H)
MS04: Manage native species (incl. non-Directive species)	Medium (M)

9.6 Additional information

No additional information

10. Future prospects

10.1a Future trends of parameters

ai) Range	Very Negative - decreasing >1% (more than one percent) per year on average
bi) Population	Very Negative - decreasing >1% (more than one percent) per year on average
ci) Habitat for the species	Positive - slight/moderate improvement

10.1b Future prospects of parameters

aii) Range	Bad
bii) Population	Bad
cii) Habitat for the species	Poor

10.2 Additional information

No additional information

11. Conclusions

11.1 Range	Unfavourable-bad (U2)
11.2 Population	Unfavourable-bad (U2)
11.3 Habitat for the species	Unfavourable-bad (U2)

11.4 Future prospects	Unfavourable-bad (U2)
11.5 Overall assessment of Conservation Status	Unfavourable-bad (U2)
11.6 Overall trend in Conservation Status	Deteriorating

11.7 Change and reason for change in conservation status

This field is not reported as the period 2019-2024 marks the first instance in which conservation status has been assessed at the national level, meaning no comparisons to previous reports can be drawn.

11.7 Change and reason for change in conservation status trend

This field is not reported as the period 2019-2024 marks the first instance in which conservation status has been assessed at the national level, meaning no comparisons to previous reports can be drawn.

11.8 Additional information

No additional information

12. UK National Site Network (pSCIs, SCIs, SACs) coverage for Annex II species

12.1 Population size inside the pSCIs, SCIs and SACs network

a) Unit	number of map 1x1 km grid cells
b) Minimum	
c) Maximum	
d) Best single value	22
12.2 Type of estimate	Best estimate
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	Increasing
12.5 Short-term trend of population size within the network; Method used	Complete survey or a statistically robust estimate
12.6 Short-term trend of habitat for the species inside the pSCIs, SCIs and SACs network; Direction	Increasing
12.7 Short-term trend of habitat for the species inside the pSCIs, SCIs and SACs network; Method used	Based mainly on extrapolation from a limited amount of data

12.8 Additional information

No additional information

13. Complementary information

13.1 Justification of percentage thresholds for trends

No justification information

13.2 Trans-boundary assessment

No trans-boundary assessment information

13.2 Other relevant information

No other relevant information

14. References

Biogeographical and marine regions

4.2 Sources of information

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Main pressures

8.2 Sources of information

No sources of information

15. Explanatory Notes

Field label	Note
2.1: Sensitive species	Yes. Freshwater pearl mussel is vulnerable to illegal pearl fishing.
2.4: Distribution map; Method used	The distribution of pearl mussel in Wales is considered to be well known. Although it is possible that a few small unknown populations may exist, this is unlikely to significantly affect the range calculation.
3.1: Is the species taken in the wild/ exploited	Taking or killing this species is forbidden under the Wildlife & Countryside Act 1981 (as amended).
5.4: Short-term trend; Magnitude	Since the last reporting cycle, pearl mussel has been lost from 5 of 14 10km squares where it was previously thought to occur (35%). This is thought to represent an extinction debt, as populations within these squares had already shrunk to very small sizes.
5.8: Long-term trend; Magnitude	The range of pearl mussel in Wales in 1980 is estimated to have been approximately 9,000km2. The current range is 23% of this value. The average annual rate of decrease is estimated at 159km2 per year, equivalent to a 1.76% annual decrease.
5.9: Long-term trend; Method used	The distribution of pearl mussel in Wales was well established during the period 1989-1999, when it was already clear that most populations were declining. The Favourable Reference Range in Wales for Freshwater Pearl Mussel is estimated to be approximately 9,000km2.
5.11: Change and reason for change in surface area of range	Maps of species range are provided in Figure 2. Freshwater pearl mussel has been recorded or is expected to have occurred in at least 62 10km squares across Wales (Figure 1). There has been a further reduction in species range, from 14 10km squares in the last reporting period to 9 10km squares in the current cycle (Section 2). Freshwater pearl mussel is extinct in most of its range in

	South and Mid Wales, with most of its remaining range focussed around rivers draining Eryri, where better water quality and lower levels of habitat modification still exist. Overall, this species is estimated to occur in only 14.5% of its former squares. In most of these, populations are small and further loss of range is likely in the near future.
6.2: Population size	Best Single Value = 59 (43 confirmed, 16 interpolated – see Hatton-Ellis 2025, Figure 6.1) Remaining populations are small, low density and fragmented. Although there are no formal count data, it is likely that there are fewer than 1500 individuals remaining in the wild in Wales. The number of occupied 1km squares is 10.3% of the FRV and is not considered to be viable at present.
6.4: Quality of extrapolation to reporting unit	The interpolation method has produced a relatively small proportion of additional squares, so is unlikely to have greatly affected the estimate.
6.6: Population size; Method used	Current data are considered reasonably comprehensive. Recent survey work in support of the LifeDeeRiver and 4Rivers4LIFE projects has confirmed presence and absence in several locations.
6.8: Short-term trend; Direction	Compared to the 2019 report, there have been losses from 5 confirmed 1km squares and 14 probable 1km squares (19 in total). This represents a 25% reduction in population as measured by this metric.
6.9: Short-term trend; Magnitude	The current rate of decline represents a 4% annual rate of population decline.
6.12: Long-term trend; Direction	There is very clear evidence of a decrease in pearl mussel populations over the longer term including the extinction of a number of populations (Killeen 2007 – see Annexe 1 for a summary). Since 1989 populations have been lost from the Tâf, Western Cleddau, Eastern Cleddau, Nyfer, Aeron, Teifi,

	Tywi, Gwyrfai and Welsh Severn populations. Populations on the Dee and Conwy are critically endangered.
6.13: Long-term trend; Magnitude	The population decrease exceeds 1% per year.
6.14: Long-term trend; Method used	Repeat surveys at former sites have confirmed loss of populations. In view of the almost total absence of recruitment in the wild, this is expected.
6.15: Favourable Reference Population (FRP)	570 1km squares (222 confirmed, 348 interpolated). See Map 6.2. An FRV population using the 1km squares measure has been calculated for Wales (Map 6.2) based on available records and literature reviews (Killeen et al. 1999, 2003; Killeen & Moorkens 1999, 2003; Killeen & Oliver 1997, 1998; Oliver et al. 1993). Mussels found are invariably older individuals of 80+ years in age and for this reason all records have been included in the FRV estimate, irrespective of the date of the record, because any newly discovered mussel populations would also have been present in 1994. Due to the relative paucity, and spatial and temporal imprecision of older records for pearl mussel, a certain amount of expert judgment has been required. However, available data clearly indicate that freshwater pearl mussels were formerly widespread and reasonably common in Welsh rivers.
6.18: Age structure, mortality and reproduction	All surveys of Welsh pearl mussels indicate that populations consist predominantly or entirely of old individuals, often 80+ years in age. Lack of recruitment has already resulted in the extinction of several populations and without urgent conservation action, both in-river and across catchments, this species is expected to be extinct in Wales within 20 years.
7.1: Sufficiency of area and quality of occupied habitat	Decline in pearl mussel populations is due to a combination of habitat extent and quality, accidental mortality during in-river works (e.g. dredging) and pearl fishing. There are no

recent cases of pearl fishing recorded from Welsh rivers, reflecting the very low abundance of mussels here. Lack of population recovery therefore reflects a habitat damage and destruction at a reach and a subcatchment scale. In particular, there is a severe lack of suitable nursery habitat for juvenile mussels, resulting in a total lack of recruitment in the wild (Hatton-Ellis 2018).

Reach scale damage is mainly geomorphological, in particular removal of large material such as boulders and large woody debris that create the variable flow conditions and stable riverbed conditions pearl mussels need (Degerman et al. 2009). The remaining gravels tend to be much more mobile and are therefore insufficient to support juvenile mussels over the c. 5 year period they live buried in gravels.

Catchment scale impacts include drainage and intensification of land use that increases clogging and deoxygenation of remaining river gravels and sands. Redox measurements of river gravels, which measure the suitability of juvenile habitat by examining oxygen levels in the sediments, predominantly indicate that sediment quality is insufficient to support juvenile mussels (Killeen 2012, 2013, 2014, 2015; NRW unpublished data from 2016-2024).

Thus, river gravels in Wales are either too unstable or too poorly oxygenated for successful mussel recruitment.

More recent redox surveys have indicated localised improved conditions in restored sections of the Afon Eden (NRW, unpublished data). However, further monitoring is required to confirm this.

Redox surveys in unoccupied but potentially suitable habitats based on other characteristics have recorded similarly poor conditions (LifeDeeRiver Project, unpublished data).

7.2: Sufficiency of area and quality of occupied habitat; Methods used	Habitat quality has only been assessed in detail on the Afon Eden SAC (Killeen 2004, 2014, 2015, Garrett & Thomas 2012, NRW unpublished data). The river is divided into identifiable sections and transects record the number of sample points that meet defined criteria of suitability: • A substrate comprising a size range from coarse (1mm) to small cobble (100mm), but principally of stable gravel in riffles and runs • No filamentous algae in potential mussel beds. • No obvious siltation in the surface layers of gravels in potential mussel areas. Other rivers have had more limited surveys with less repeat data. Since 2017 NRW has been gradually accumulating data on habitat quality from a range of different potential pearl mussel habitats across Wales. These data require further analysis but the general picture does not appear to differ significantly from that outlined above.
7.5: Short-term trend; Method used	There are insufficient short-term monitoring data to report with certainty on trends in habitat. It is hoped that recent habitat restoration work will result in an improvement to habitat status, but further monitoring is required to confirm this.
7.8: Long-term trend; Method used	Long-term datasets relevant to pearl mussel are lacking. However, siltation is widely recognised as an important pressure on river ecosystems, and instances of damage to pearl mussel habitat have been recorded during the 1990s and early 2000s.
8.1: Characterisation of pressures	Pressures: The most important impacts on pearl mussel populations are morphological changes to rivers as a result of dredging work, and associated land drainage. These have resulted in

	destabilisation of river substrates and banks, increased siltation, higher flows and clogging of gravels and sands with fine material (e.g. Geist & Auerswald 2007; Pulley et al. 2019). These activities also help transport pollutants from agriculture, forestry and other land management. Forestry can have a significant effect on pearl mussel populations through water pollution, drainage and hydromorphology (Degerman et al. 2009; Cosgrove et al. 2017). The extent of forestry in pearl mussel catchments in Wales is localised, and its water pollution and hydromorphological effects are therefore considered moderate. Increased storminess due to climate change is likely to result in greater flooding, causing washout of adult and juvenile mussels and the eggs of their salmonid hosts. Droughts causing excessive low flows also have the potential to harm or even eradicate populations (Cosgrove et al. 2022). These impacts have or are expected to further destabilise rivers. Threats: Threats are broadly the same as pressures. It is expected that forestry impacts will reduce as forestry is removed and habitats restored in pearl mussel catchments, hence the threat from forestry impacts has been downgraded to low. Climate change risks are expected to increase over the coming decades and the risk of impacts therefore increases from medium to high. There have been no reported cases of illegal pearl fishing in Wales hence current impact is assessed as zero, but there is a residual threat assessed as Low.
9.1: Status of measures	A conservation strategy is in place and is being implemented via various habitat restoration projects and a reintroduction programme.

9.2: Main purpose of the measures taken	c) Increase the population size and/or improve population dynamics (improve reproduction success, reduce mortality, improve age/sex structure) (related to 'Population') or d) Restore the habitat of the species (related to 'Habitat for the species') Due to the highly endangered status of this species, both c) and d) are required, and in all likelihood all of a)-d) apply.
9.3: Location of the measures taken	Due to the very small extent of SAC sites designated for pearl mussel in Wales, a high proportion of works are required outside SAC sites.
9.4: Response to the measures	The strategy has been in place since 2017 and initial positive results are starting to be evident. However, the slow reproductive rate of pearl mussels requires a long-term approach.
9.5: List of main conservation measures	Habitat restoration and catchment management Key to the long-term sustainable future of freshwater pearl mussel in Wales will be the establishment of river reaches where habitat conditions are suitable for mussel recruitment in the long-term. This requires a combination of actions to reverse or mitigate past habitat damage including drainage (MA13, MB14), hydropower scheme management (MC04), general morphological damage such as removal of boulders and channel straightening (MA13, MB14, MK03) and management of short-term impacts on and risks to water quality (MA10, MB10, MK01). Integrated catchment management is essential alongside this habitat works and will predominantly need to be carried out in partnership with the agricultural and forestry sectors. A LIFE project, Pearls in Peril, took place between 2012 and 2016 and included action in Afon Eden, the only Welsh SAC designated for pearl mussel. This included various measures including fencing, sediment traps (CB14), ditch blocking (CB14) and replacement of boulders to the river (CS03).

Further boulder and gravel replacement were completed in the catchment in a Welsh Government funded project led by Snowdonia National Park, and a further 850t of boulders and 350t of gravel were returned to the river by NRW in 2022 (Hatton-Ellis et al. 2023). Redox measurements show some evidence of improvements as a result (NRW, unpublished), but further data collection is required to confirm this.

NRW is currently in discussions with the operator regarding measures to reduce the impact of a hydropower scheme that abstracts water from the Afon Eden (CC04).

Two more LIFE projects, LIFEDeeRiver and 4Rivers4LIFE, are currently under way in Wales. Both of these projects are restoring pearl mussel habitats and planning the reintroduction of captive reared mussels to rivers in their respective project areas.

The previous Welsh agrienvironment scheme Glastir has now come to an end, and will be replaced by the Sustainable Farming Scheme following Brexit. Full details of this scheme are not yet available but it is expected that provision will be included for measures that benefit pearl mussels, including the opportunity for tailored collaborative projects.

In the Afon Ddu, works since 2005 with 640 metres of river fenced out to stop cattle and livestock access and another 820 metres restored through replacement of boulders and re-introduction of gravel . In addition three fish barriers have been ameliorated. In 2024, further boulder, woody debris and gravel replacement has been carried out by an NRW project.

There has been a large amount of restoration works carried out in the Irfon catchment as part of the ISAC project (WUF 2018b) in which 32km of SAC designated sections of the

Cledan, South Dulas, Cammdwr, Cammarch, Cynffiad, Garth Dulas and Chwefru were restored. Work included double bank fencing, erosion repair, coppicing and introducing instream features and water gates. In the forested parts of the upper catchment, coniferous trees were removed, drainage reduced and forest design plans altered. In 2022, NRW set up the multi-year Upper Wye project which covers the Afon Irfon amd will look to restore habitat as well as address catchment pressures. In 2024, stock exclusion work has been carried out in a key area of river between Builth Wells and Garth.

The Freshwater Habitats Trust is taking a similar approach of reducing pollution and improving river habitat by working with local farmers and landowners in the 'River Irfon Catchment Project'.

NRW is continuing to deliver habitat monitoring and survey work to identify measures that can conserve other pearl mussel populations elsewhere in Wales.

Measures to ensure that populations of salmonid hosts are sufficient to support mussel recruitment may be needed in some circumstances.

Captive Rearing

Remaining pearl mussel populations in Wales are unlikely to be viable (see Bergengren et al 2004; Degerman et al 2009) due to very low mussel numbers. Therefore, we cannot rely only on habitat measures alone to ensure the survival of pearl mussels in Wales (Hatton-Ellis et al. 2017) and a programme of captive rearing for the purpose of population reinforcement (CS01) and reintroduction (CS02) is under way to ensure short and medium term persistence and improve the long-term prospects for recovery. Population reinforcement will also improve survival chances of remaining populations, as there is evidence that pearl mussel recruitment improves at higher densities (Arvidsson

	et al. 2012). Pearl Mussel captive rearing is currently under way at two NRW hatcheries in Powys, Cynrig and Clywedog, and the Freshwater Biological Association hatchery at Windermere. With the support of LIFE funding, NRW has reopened the Clywedog hatchery specifically for pearl mussel rearing where these activities can be carried out on a larger scale, and where adults can be safely housed. Additionally, the facilities for juvenile rearing at Cynrig have been refurbished. As a result, adult mussels from the Eden, Irfon, Dee, Nyfer, Dwyfor and Conwy are all being captive reared. Captive rearing has been slower than anticipated due to the difficulty of finding suitable donor stock and because mussels have not spawned successfully every year, but juvenile mussels are currently being reared in the hatchery. In 2024, the first releases of captive reared mussels were carried out on the Eden under controlled conditions, with the aim of reinforcing and rejuvenating the existing population there. Further releases are planned both here and in other rivers once the necessary habitat restoration works are complete. A further c. 3000 juvenile mussels are in the hatchery awaiting reintroduction.
10.1: Future trends and prospects of parameters	Future prospects of -range. Future trend in range is dependant on the success and nature of conservation measures. However, due to the fragmented distribution and small size of many populations, further losses of range are likely in the short term at least. In the longer term it is hoped that losses in range can be stabilised and to some extent reversed. Future prospects of -Population Future trend in population is dependant on the success and nature of conservation measures. However, due to the fragmented distribution and small size of many populations,

	further losses of population are likely in the short term at least. The key focus at present is preventing extinction in Wales by reversing the population trend. Future prospects of -Habitat of the species At present, habitat quality and probably extent are insufficient to maintain freshwater pearl mussel populations in Wales. Although there is no particular reason to expect further decline, the status quo will inevitably result in extinction of pearl mussel from Wales. A key priority is the ongoing restoration work to reinstate natural geomorphology on pearl mussel rivers. Alongside integrated catchment management, this will recreate habitat conditions where populations can thrive. It is hoped that we will see improvements to habitat quality become increasingly apparent and widespread in the next 5-10 years.
11.1: Range	Range is assessed as Unfavourable – Bad because range in Wales is less than 23% of the Favourable Reference Range and declining by more than 1% per year.
11.2: Population	Population is assessed as Unfavourable – Bad because population in Wales is 10% of the Favourable Reference Population and declining by more than 1% per year.
11.3: Habitat for the species	Habitat for the species is assessed as Unfavourable – Bad because current habitat is inadequate to support juvenile recruitment and therefore viable populations at any Welsh locality Conclusion on Habitat for the species reached because: (i) the area of occupied habitat is not sufficiently large for long-term survival of the species (ii) the quality of occupied habitat is not suitable for the long-term survival of the species; and iii) there is a not a sufficiently large area of occupied and unoccupied habitat of suitable quality for long term survival (iv) the short-term trend in area of habitat is unknown; and v) expert opinion determines that the habitat

	quality of occupied and unoccupied habitat is bad; and vi) expert opinion determines that the habitat area is insufficient, but not clearly so.
11.4: Future prospects	Conclusion on Future prospects reached because: (i) the Future prospects for Range are bad; (ii) the Future prospects for Population are bad; and (iii) the Future prospects for Habitat for the species are poor. Future prospects are assessed as Unfavourable – Bad because the FCS Assessment process requires this based on the responses to 11.1-11.3 above. It should be noted that the Conservation Measures explained in Section 9 are expected to stabilise Range and Population and improve Habitat for the Species before the next reporting round. We therefore recommend that Future Prospects could be considered to be Unfavourable – Inadequate (U1).
11.5: Overall assessment of Conservation Status	A Conclusion of Unfavourable – Bad has been reached because Range, Population and Habitat for the Species have all been assessed as Unfavourable – Bad.
11.6: Overall trend in Conservation Status	A qualifier of deteriorating has been added because Range and Population are both deteriorating by 1% or more per ear.
11.7: Change and reasons for change in conservation status and conservation status trend	NRW (2019) previously informally assessed Freshwater Pearl Mussel as Unfavourable – Bad and Declining. This assessment is unchanged.
12.1: Population size inside the pSCIs, SCIs and SACs network	Number of 1km Squares: Designated for Pearl Mussel: 7 (Afon Eden). Other UK National Site Network Sites: 15 (River Wye; River Dee and Llyn Tegid). Afon Eden still contains the highest densities of pearl mussels in Wales. However, the population there is very

	small by global standards and the habitat is not in favourable condition. The populations in the River Wye and River Dee and Llyn Tegid are much smaller and at serious threat of extinction.
12.3: Population size inside the network; Method used	All three rivers have recently been monitored as part of delivery of the pearl mussel strategy.
6.15: Favourable Reference Population (FRP)	The UK-level FRV for population was developed by JNCC using an audit trail based on the year the FRV was first established and any changes made in subsequent reporting rounds. The audit may draw from any combination of the 2007, 2013, or 2019 Habitats Directive reports and reflects the full rationale used for the 2019 Article 17 reporting. Following expert review, a Wales-level FRV was derived based on population trend and abundance data specific to Wales, rather than adopting the UK-level value. The revised FRV has been set as unpublished NRW GIS analysis indicated that the Wales FRP could be estimated at 573 1 x 1 km grid squares, with the current population being 90% smaller at 59 1 x 1 km grid sqaures. Therefore the operator of between 51% and 100% smaller than the FRP was selected.
5.10: Favourable Reference Range (FRR)	The UK-level FRV for range was developed by JNCC using an audit trail based on the year the FRV was first established and any changes made in subsequent reporting rounds. The audit may draw from any combination of the 2007, 2013, or 2019 Habitats Directive reports and reflects the full rationale used for the 2019 Article 17 reporting. Following expert review, a Wales-level FRV was derived based on distribution and trend evidence specific to Wales, rather than adopting the UK-level value. The revised FRV has been set as unpublished NRW GIS analysis indicated that the Wales FRR could be 9000 km2 with the current range being approximately 77% smaller

than this at 2114 km2. Therefore an operator of 'between 51% 100% smaller than FRR' was selected for this species.