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:

S1102 - Allis shad (*Alosa alosa*)

WALES

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 (Wales information only)**
1.2 Species code	**1102**
1.3 Species scientific name	**Alosa alosa**
1.4 Alternative species scientific name	
1.5 Common name (in national language)	Allis shad

2. Maps

2.1 Sensitive species	No
2.2 Year or period	1996-2018
2.3 Distribution map	Yes
2.4 Distribution map Method used	Based mainly on expert opinion with very limited 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

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

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

Alexandrino P, Faria R, Linhares D, Castro F, Le Corre M, Sabatie R, Bagliniere J-L, Weiss S. 2007. Interspecific differentiation and intraspecific substructure in two closely related clupeids with extensive hybridisation, Alosa alosa and Alosa fallax. Journal of Fish Biology 69 (Supplement B): 242-259.
Aprahamian MW, Lester SM, Aprahamian CD. 1999. Shad Conservation in England and Wales. Environment Agency R & D Technical Report W110. Environment Agency, Bristol.
Aprahamian MW, Bagliniere J-L, Sabatie R, Alexandrino P, Aprahamian CD. 2002. Alosa alosa and Alosa fallax spp.: Literature Review and Bibliography. R&D Technical Report W1-014/TR. Environment Agency, Swindon.
Aprahamian MW, Aprahamian CD, Knights AM. (2010) Climate change and the green energy paradox: the consequences for twaite shad Alosa fallax from the River Severn, U.K. Journal of Fish Biology, 77, 1912-1930.
Atkins Ltd. 2004. Assessment of Obstructions to Shad Migration on the River Usk. CCW RoC Report No. 16.
Caswell, P. A., and M. W. Aprahamian. 2001. Use of River Habitat Survey to determine the spawning habitat characteristics of Twaite Shad (Alosa fallax fallax). Bulletin Francais de la Peche et de la Pisciculture 362/363: 919-929.
Crundwell C. 2018. Twaite shad (Alosa fallax) data provided to Natural England and Natural Resources Wales for the purpose of undertaking the Article 17 assessment for the Severn Estuary Special Area of Conservation under the Habitats Directive. Unpublished note from the Unlocking the Severn Project.
Faria R, Pinheiro AN, Gabaldon T, Weiss S, Alexandrino P. 2011. Molecular tools for species discrimination and detection of hybridization between two closely related clupeid fishes Alosa alosa and A. fallax. Journal of Applied Ichthyology

27:16-20.
Garrett, HM, 2015. Afon Tywi SAC shad spawning assessment 2015 (Alosa alosa & Alosa fallax), incorporating classification of 2013 and 2014 survey data. NRW Evidence report no 87. 29pp, Natural Resources Wales, Bangor.
Garrett, HM. 2017a. River Usk SAC Allis & Twaite shad population condition assessment. Reporting cycle 2013 to 2018. 23 pp. Natural Resources Wales. Dolgellau.
Garrett, HM. 2017b. River Wye SAC Allis & Twaite shad population condition assessment. Reporting cycle 2013 to 2018. 23 pp. Natural Resources Wales. Dolgellau.
Hardouin EA, Stuart S, Andreou D. 2013. Monitoring Allis and Twaite Shad: quality assurance and species identification using molecular techniques. NRW Evidence Report No: 1, 41pp, Natural Resources Wales, Bangor.
Henderson PA. 2003. Background information on species of shad and lamprey. CCW Marine Monitoring Report No: 7 ; 30pp. Bangor: Countryside Council for Wales.
Hillman RJ, Cowx IG, Harvey JP. 2003. Monitoring Allis & Twaite Shad. Conserving Natura 2000 Rivers Monitoring Series 3. English Nature, Peterborough.
Interagency Freshwater Group (IAFG). 2018. Procedure for Estimating Population (including Favourable Reference Population) using 1km Square Resolution Records Data.
Joint Nature Conservation Committee (JNCC). 2007. Second Report by the UK under Article 17 on the implementation of the Habitats Directive from January 2001 to December 2006. Peterborough: JNCC. Available from: www.jncc.gov.uk/article17
Knights AM. 2014. Modelling the response of the twaite shad (Alosa fallax) population in the Afon Tywi SAC to a modified temperature regime. Bangor, Natural Resources Wales. NRW Evidence Report No. 6.
Maitland P, Hatton-Ellis T. 2003. Ecology of the Allis and Twaite Shad. Conserving Natura 2000 Rivers Ecology Series 3. Peterborough, English Nature.
Natural Resources Wales (unpublished) shad monitoring data 2013-2017. Dataset stored on the DMS.
Natural Resources Wales, 2018a. Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report Series, Report No: 225, 49pp, NRW, Bangor.
Natural Resources Wales 2018b. Severn Estuary / Mor Hafren Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report Series, Report No: 235, 41pp, NRW, Bangor.
Natural Resources Wales, 2018c. Pembrokeshire Marine / Sir Benfro Forol Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report Series, Report No: 233, 67pp, NRW, Bangor.
Phillips MB, Bonner TH. 2015. Occurrence and amount of microplastic ingested by fishes in watersheds of the Gulf of Mexico. Marine Pollution Bulletin, 100: 264-269.
Severn Rivers Trust. 2018. Unlocking the Severn. http://severnriverstrust.com/projects/unlocking-the-severn/ Accessed 12th July 2018.
Stone, D.M. (2015). Monitoring Allis and Twaite Shad: quality assurance and species identification using molecular techniques. NRW Evidence Report 53. Bangor, Natural Resources Wales.
Thomas Rh, Dyson C. 2011. River Usk shad egg survey 2010. CCW staff science report no. 10/8/1. Countryside Council for Wales, Bangor.

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

Thomas Rh, Dyson C. 2012a. River Wye Shad Egg Survey 2011. CCW Staff Science Report No. 11/8/4. Countryside Council for Wales, Bangor.
Thomas Rh, Dyson C. 2012b. River Usk Shad Egg Survey 2011. CCW Staff Science Report 11/8/3. Countryside Council for Wales, Bangor.
WFD waterbody classifications (2015). 2009-2015 Classification Data: http://waterwatchwales.naturalresourceswales.gov.uk/en/

5. Range

5.1 Surface area (km²)		
5.2 Short-term trend Period		
5.3 Short-term trend Direction	Uncertain (u)	
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) b) Operator c) Unknown d) Method	
5.11 Change and reason for change in surface area of range	Improved knowledge/more accurate data The change is mainly due to:	Improved knowledge/more accurate data
5.12 Additional information		

6. Population

6.1 Year or period	2013-2018	
6.2 Population size (in reporting unit)	a) Unit b) Minimum c) Maximum d) Best single value	number of map 1x1 km grid cells (grids1x1) 181
6.3 Type of estimate	Best estimate	
6.4 Additional population size (using population unit other than reporting unit)	a) Unit b) Minimum c) Maximum d) Best single value	
6.5 Type of estimate		
6.6 Population size Method used	Complete survey or a statistically robust estimate	
6.7 Short-term trend Period	2006-2018	

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

6.8 Short-term trend Direction	Stable (0)
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	1994-2018
6.12 Long-term trend Direction	Increasing (+)
6.13 Long-term trend Magnitude	a) Minimum b) Maximum c) Confidence interval
6.14 Long-term trend Method used	Complete survey or a statistically robust estimate
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	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

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)?	Yes
7.2 Sufficiency of area and quality of occupied habitat Method used	Complete survey or a statistically robust estimate	
7.3 Short-term trend Period	2012-2018	
7.4 Short-term trend Direction	Stable (0)	
7.5 Short-term trend Method used	Complete survey or a statistically robust estimate	
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
Mixed source pollution to surface and ground waters (limnic	M

and terrestrial) (J01)	
Mixed source marine water pollution (marine and coastal) (J02)	M
Abstraction from groundwater, surface water or mixed water (K01)	M
Modification of hydrological flow (K04)	H
Physical alteration of water bodies (K05)	H

Threat	Ranking
Mixed source pollution to surface and ground waters (limnic and terrestrial) (J01)	M
Mixed source marine water pollution (marine and coastal) (J02)	M
Abstraction from groundwater, surface water or mixed water (K01)	M
Modification of hydrological flow (K04)	M
Physical alteration of water bodies (K05)	H
Wind, wave and tidal power, including infrastructure (D01)	H

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

Increase the population size and/or improve population dynamics (improve reproduction success, reduce mortality, improve age/sex structure) (related to 'Population')

9.3 Location of the measures taken

Both inside and outside 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 agricultural activities (CA11)
Manage water abstraction for resource extraction and energy production (CC13)
Reduce impact of mixed source pollution (CJ01)
Restore habitats impacted by multi-purpose hydrological changes (CJ03)
Other measures related to mixed source pollution and multi-purpose human-induced changes in hydraulic conditions (CJ04)

9.6 Additional information

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

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	182
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	Stable (0)	
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

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

Distribution Map

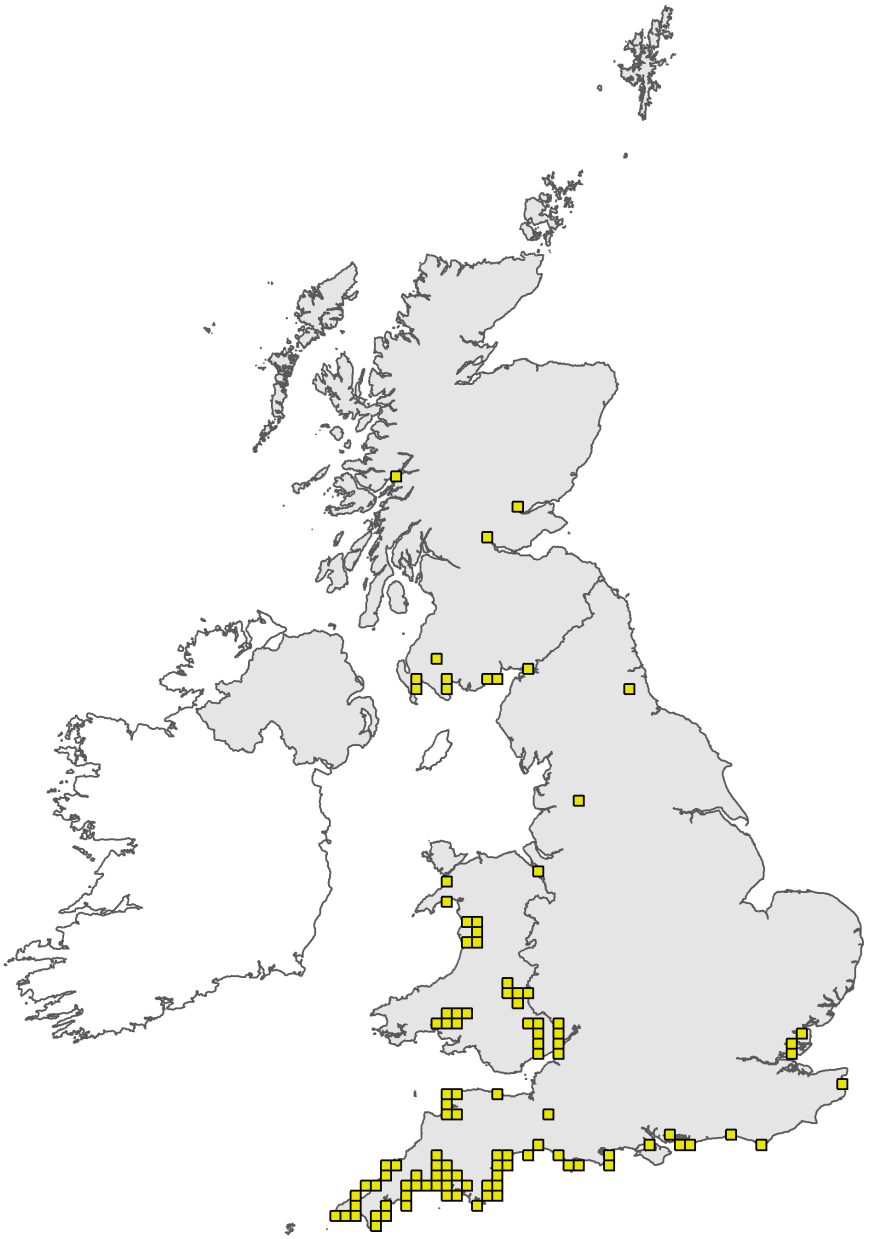

Figure 1: UK distribution map for S1102 - Allis shad (*Alosa alosa*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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

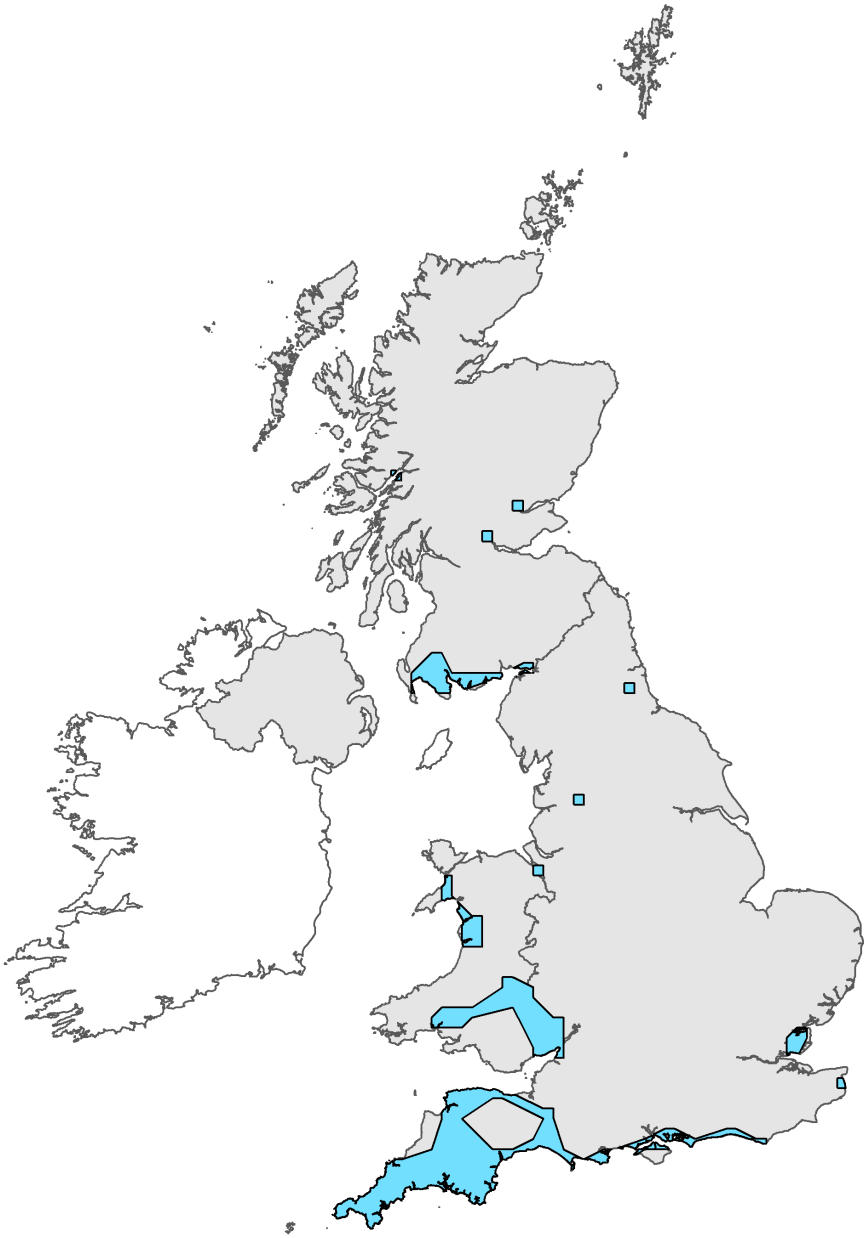

Figure 2: UK range map for S1102 - Allis shad (*Alosa alosa*). Coastline boundary derived from the Oil and Gas Authority's OGA and Lloyd's Register SNS Regional Geological Maps (Open Source). Open Government Licence v3 (OGL). Contains data © 2017 Oil and Gas Authority.

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: Alosa alosa (1102)

Field label	Note
2.4 Distribution map; Method used	Due to underreporting and difficulties in detecting and identifying the species, the exact distribution of allis shad in Wales remains very uncertain (see also the commentary in section 1.1 of JNCC (2007)). Spawning distribution is probably focused around the larger rivers entering the Bristol Channel, especially the Usk, Wye and Tywi. Individuals are sporadically caught in other rivers around the Welsh coast such as the Dee and Conwy, but there is no evidence of spawning in either river. Historically the largest UK population was in the Severn where fish reached as far as Welshpool (Aprahamian et al. 1999) but this was eradicated by construction of navigation weirs that blocked access to spawning grounds. Other (Welsh) records are likely to be stray individuals or marine / estuarine records.
3.2 Which of the measures in Art. 14 have been taken?	Under the Wildlife & Countryside Act 1981 (as amended) it is illegal to fish for allis shad. Any specimens caught unintentionally must be released alive.

Species name: Alosa alosa (1102) Region code: ATL

Field label	Note
5.11 Change and reason for change in surface area of range	Unknown The range of allis shad in Welsh rivers and seas is largely unknown and data are very poor, but generally suggest that shad are widespread but rare. Detection is hampered by the presence of the much more frequent twaite shad (Alosa fallax, S1103), with which allis shad hybridises.
6.2 Population size	We have no confirmed records of allis shad spawning in Wales. However, records of large shad consistent with allis in the Wye, Usk and Tywi, plus the presence of hybrid fish provide strong circumstantial evidence that allis shad are present. We have therefore used the population figure for twaite shad, reflecting the approach that was also taken in 2012 (Hatton-Ellis 2012), on the basis that sections of river accessible to and suitable for twaite shad spawning will also be suitable for allis shad. See Map 6.2. No relevant population data are available for marine waters.
6.4 Additional population size	Previously shad were assessed using the length of river occupied (Hatton-Ellis et al. 2012). Since the EU reporting unit is an equivalent unit, river length has not been recalculated. Instead, the 2013 population unit has been converted to the current unit for the purposes of calculating trends. An interagency paper (IAFG 2018) has agreed to standardise freshwater species methods in rivers, including shad, using the EU reporting unit where available.
6.6 Population size; Method used	Surveys were carried out at suitable habitat in rivers where Alosa sp(p). spawning has been previously recorded. The rivers in Wales where shad spawn (Usk, Wye, Tywi) are well known (see Aprahamian et al. 1999; JNCC 2007) and are designated as SACs. Isolated spawning events could have occurred in other rivers but these are hard to detect. However, we do not know which records refer to allis shad and which to twaite.
6.8 Short term trend; Direction	Between 2006-2018, using the same methods as above, 188 1km squares contained shad or shad eggs.
6.9 Short term trend; Magnitude	No significant trend is apparent.

6.10 Short term trend; Method used	Estimates of short and long term change are based on available monitoring data. Monitoring shad populations is technically very challenging. It is only recently that a cost-effective method based on egg surveys has been developed and deployed (see Thomas & Dyson 2011, 2012a, 2012b, Garrett 2012, 2015, 2017a, 2017b), though it should be noted that this approach focuses more on the spatial distribution of spawning within a river rather than attempting absolute estimates of population size or allocation to specific shad species. As a result it has been possible to compare current results with maps of spawning distribution in Welsh rivers (Aprahamian et al. 1999), produced by compiling data from the 1990s. See also NRW (2012).
6.12 Long term trend; Direction	Long-term trend was reported as increasing in 2013 and this is assumed still to apply. However, due to taxonomic issues we cannot confidently say whether allis shad have increased.
6.13 Long term trend; Magnitude	Not available. Long-term trend data are available but would need to be recalculated to match the revised reporting unit.
6.14 Long term trend; Method used	Estimates of short and long term change are based on available monitoring data. Monitoring shad populations is technically very challenging. It is only recently that a cost-effective method based on egg surveys has been developed and deployed (see Thomas & Dyson 2011, 2012a, 2012b, Garrett 2012, 2015, 2017a, 2017b), though it should be noted that this approach focuses more on the spatial distribution of spawning within a river rather than attempting absolute estimates of population size or allocation to specific shad species. As a result it has been possible to compare current results with maps of spawning distribution in Welsh rivers (Aprahamian et al. 1999), produced by compiling data from the 1990s. See also NRW (2012).
6.15 Favourable reference population	235 (Wales only). See map 6.15. Despite the paucity of data, the combination of genetic (Hardouin et al. 2013; Stone 2014), historical (Aprahamian et al. 1999 and NBN Data) and circumstantial evidence provides strong support for the twaite shad FRV map also being applicable to allis shad.
6.17 Additional information	The population reporting unit has changed from length of river occupied to number of occupied 1km squares. The FRP has been recalculated for Wales due to the change in reporting unit from 2007-12. This figure represents the translation of the 2012 FRP (Hatton-Ellis et al. 2012) into number of occupied 1km squares using the UK River Species Interpolation Method (Hatton-Ellis 2018). Note that only freshwater 1km squares are included in this value. The favourable reference population in Wales has also been slightly reduced based on new information indicating that parts of the Upper Tywi are too cold to support a shad population (Knights 2014) and therefore should not be included in the favourable reference range.

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)? - area = NO Shads use multiple habitats at different stages of their life history, all of which are critical to survival. The most important factor is that all habitat types are accessible and of at least adequate quality. Construction of weirs in the 19th and 20th Century largely eradicated allis shad from the Severn, its largest UK population (Aprahamian et al. 1999, Maitland & Hatton-Ellis 2003). Marine habitat requirements are poorly understood, but they seem to be mainly coastal and pelagic in habit, having been reported from depths between 10-150 m. A suitable estuarine habitat is likely to be very important for adults and juveniles (Maitland and Hatton-Ellis, 2003). - quality = Unknown In Wales, allis shad occur in 12 Water Framework Directive (WFD) river water bodies in Wales, constituting about 290km of habitat. None of these water bodies were classed as Heavily Modified and where Morphology or Hydrological Regime had been assessed, all water bodies were considered to support Good Status for morphology / hydromorphology. 2015 WFD Classification data indicates that 3 of these water bodies were at Good Status and 10 were at Moderate Status. Failing WFD elements included phosphate, copper, macrophytes & phytobenthos, zinc, priority substances, and fish. Although these failures are spatially wide-ranging, their magnitude tends to be small. In five of the water bodies reported as being at Moderate Status, this classification was Uncertain, which indicates that the failure was marginal in nature. WFD Tools are optimised to measure river ecological quality in generic terms and therefore the applicability of these data to shad is uncertain. The seasonal nature of shad presence in rivers will also mitigate against impacts occurring in autumn and winter. Finally, shad are probably more sensitive to morphological than water quality impacts. For water bodies supporting shad in Wales there is a mismatch between river quality and population data, river habitat quality is apparently close to the Good-Moderate boundary in most instances, and there is significant uncertainty regarding the applicability of river habitat data to shad. Therefore, in spite of the availability of extensive datasets, habitat quality is considered to be unknown. In the marine environment, most key estuarine and inshore habitat supporting shad is worse than Good status, with a range of problems identified including biological evidence of eutrophication, failing its chemical standards, with problems identified for mercury and its compounds, brominated diphenylether and dissolved inorganic nitrogen (NRW 2018a, 2018b, 2018c). Overall = NO b) If NO, is there a sufficiently large area of occupied & unoccupied habitat of suitable quality (to maintain the species at FCS)? sufficient occupied = NO sufficient unoccupied = YES Overall = YES The above conclusion applies to freshwater habitat only. Habitat in the Upper Severn in Wales is considered to be of suitable quality to support shad population were barriers to migration removed or passed. Further research is required to understand the critical tolerances of shad in the context of current environmental standards, especially in the marine environment.
7.2 Sufficiency of area and quality of occupied habitat; Method used	Water Framework Directive monitoring data provides a detailed and spatially widespread baseline, subject to the caveats regarding its ecological relevance noted above.

8.1 Characterisation of pressures/ threats	Pressures: Shads are highly sensitive to river modifications that impair fish passage (K01, K03, K04, K05). They avoid turbulent flows and do not leap over barriers. Consequently, obstructions that other migratory fish pass with relative ease can be partial or complete barriers to shad. These particularly include weirs and dams constructed for various purposes (K05), but even bridge footings (K04) can have a significant impact. Water abstractions also remove eggs drifting downstream, although the significance of this in the context of the population is uncertain. Other physical modifications to water bodies such as river straightening and bank reinforcement (K05) may damage both the riffle habitat used for spawning and the backwaters and deep pools used by juveniles in freshwater. Although shads are less pollution sensitive than fish such as salmonids, they are nevertheless vulnerable to pollution impacts (J01). Increasingly intensive farming regimes in South Wales are therefore of concern. However, since fish are only present in rivers in summer, they are less likely to be exposed to slurry pollution, which occurs mainly in winter. In the marine environment, cooling systems for power stations (D05) entrain very large numbers of fish, including juvenile shad (Henderson 2003; Aprahamian et al. 2010). These impacts cannot be reflected by the existing population or range metrics as these relate only to the freshwater stage and are predominantly spatial in nature. Further monitoring data to quantify the impact of this pressure is needed. Threats: All of the above pressures are also threats for the future. In addition, tidal power schemes (D01) that have been proposed in multiple locations around the Welsh coast are a particular cause for concern, as inappropriately designed or sited schemes could have significant negative impacts on shad populations. Twaite shad are pelagic fish and feed on small semi-transparent prey in the freshwater (J01) and marine environment (J02). This makes it likely that they ingest microplastics (cf Phillips & Bonner 2015). At present this is not monitored and the impact of this potential pressure is therefore unknown. This is an emerging area in research at present and it is hoped that appropriate monitoring may be identified to assess this threat.
9.5 List of main conservation measures	Measures selected are specifically to address pressures identified in Section 8. The highest priority actions are to continue to improve migratory access for twaite shad (CJ03, CJ04). This will likely to benefit other migratory fish such as allis shad, salmon and migratory lampreys.
10.1 Future prospects of parameters	10.1a Future prospects of - range. Positive Future trend in range in Wales is expected to be stable or increasing (see text for 10.1b). Climate change could also result in some range extensions northward by making rivers currently unused by shad more thermally suitable. 10.1b Future prospects of - Population Positive The Unlocking the Severn LIFE project (Severn Rivers Trust, 2018) has the potential to restore allis shad to virtually all of its historic range in western Britain, including Welsh sections of the Severn. Even if the project does not achieve this, it will be a strong platform for future accessibility work. 10.1c Future prospects of - Habitat of the species Overall Stable. There are no good reasons to expect a marked deterioration in habitat extent or quality for allis shad in the near future.
12.1 Population size inside the pSCIs, SCIs and SACs network	a) 1km squares. b) Not available c) Not available d) 182 (100%) All except one of the 1km squares are associated with a shad population within and specifically protected by the SAC network. A few additional records lie outside the SAC boundary but inside a corresponding 1km square for a SAC. See sections 4 and 6.2 for a discussion of the taxonomic uncertainty associated with this species.