Wels Catfish (*Silurus glanis)*

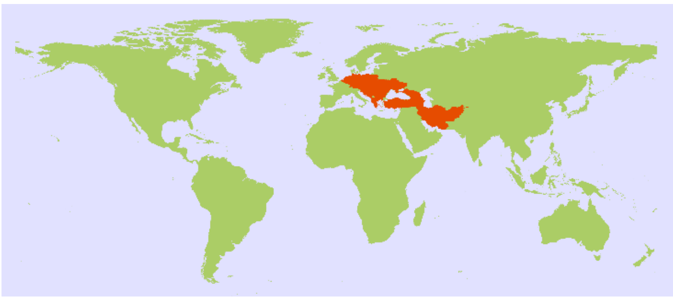
- A large (to 3m), nocturnal, bottom dwelling, freshwater catfish, with long anal fin and slimy skin.
- Native to parts of central and eastern Europe and central Asia.
- Present in over 280 still waters as well as canals and rivers in GB.
- Increasingly popular in GB as a recreational sports fish.
- As a top predator impacts causes declines in fish populations elsewhere in the world; however, these have not yet been recorded in GB.

Photograph: Watershed Council

History in GB

First introduced in the mid-19th century, primarily as a sport fish and for angling. Now established in many still-waters. It is not known whether self-sustained populations have formed in rivers; however, juveniles have been detected. Import, movements and keeping is regulated in GB; however, illegal transfer does occur.

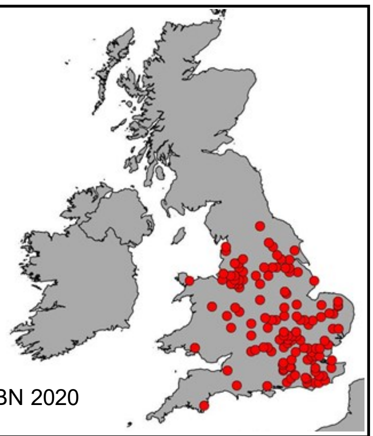
Native Distribution



Source: GBNNSIP

GB Distribution

Established in numerous sites in England and a few sites in Wales. None in Scotland.



Source: NBN 2020

Impacts

Impacts have been detected elsewhere in the world but are largely undocumented and uncertain in GB.

Environmental (moderate, low confidence)

- A potentially voracious predator of fish and crayfish. May also take or disrupt bird species.
- Evidence from Europe demonstrates an ability to cause severe declines in some native fish species including tench, pike and perch. However, other studies found little impact (e.g. in the Ebro delta). Some speculation of possible impact on eels; however, this has not been the case in France.
- As a large and rapidly growing fish it is likely to alter natural communities.
- There is a risk of disease / parasite introduction and spread, particularly with illegal movements.

Economic (minor, low confidence)

- Unlikely to cause significant economic impacts unless numbers increase to the extent that they impact on fished species.
- Costs would be incurred if this species were to require management.

Societal (minor, medium confidence)

- Unlikely to be significant

Introduction pathway

The most likely pathway of new introductions in GB is through the illegal import or introduction of fish to new water bodies.

Spread pathway

Natural (very slow, medium confidence) – adults tend to stay in the same place, resulting in slow spread through water systems.

Human (rapid, high confidence) – the primary vector of spread is transfer (legal and illegal) for sports fishing

Summary

	Response	Confidence
Entry	LIKELY	MEDIUM
Establishment	V. LIKELY	MEDIUM
Spread	MODERTE	MEDIUM
Impact	MODERATE	LOW
Overall risk	MODERATE	LOW

RISK ASSESSMENT COVERING PAGE - ABOUT THE PROCESS

It is important that policy decisions and action within Great Britain are underpinned by evidence. At the same time it is not always possible to have complete scientific certainty before taking action. To determine the evidence base and manage uncertainty a process of risk analysis is used.

Risk analysis comprises three component parts: risk assessment (determining the severity and likelihood of a hazard occurring); risk management (the practicalities of reducing the risk); and risk communication (interpreting the results of the analysis and explaining them clearly). This tool relates to risk assessment only. The Non-native Species Secretariat manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. During this process risk assessments are:

- Commissioned using a consistent template to ensure the full range of issues is addressed and to maintain a comparable quality of risk and confidence scoring supported by appropriate evidence.
- Drafted by an independent expert in the species and peer reviewed by a different expert.
- Approved by the NNRAP (an independent risk analysis panel) only when they are satisfied the assessment is fit-for-purpose.
- Approved by the GB Programme Board for non-native species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

Common misconceptions about risk assessments

The risk assessments:

- consider only the risks (i.e. the chance and severity of a hazard occurring) posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy-based decision on appropriate management.
- are advisory and therefore are part of the suite of information on which policy decisions are based.
- are not final and absolute. They are an assessment based on the evidence available at that time. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Once drafted and approved by the NNRAP and GB Programme Board, risk assessments are open for stakeholders to provide comment on the scientific evidence which underpins them for three months from the date of posting on the NNSS website. Relevant comments are collated by the NNSS and sent to the risk assessor for them to consider and, if necessary, amend the risk assessment. Where significant comments are received the NNRAP will determine whether the final risk assessment suitably takes into account the comments provided.

To find out more: published risk assessments and more information can be found at https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=22

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: Wels catfish (*Silurus glanis*) Linnaeus, 1758
Author: Gareth D Davies
Version: Draft 1 (15/11/2016); NNRAP 1 (November 2016); Draft 2 (15/02/2017); Draft 3 (07/03/19); NNRAP 2 (May 2020); Draft 4 (August 2020); NNRAP 3 (September 2020)
Risk Assessment Area: Great Britain (England, Scotland, Wales and their islands)
Signed off by NNRAP: September 2020
Approved by Programme Board: September 2021
Placed on NNSS website: February 2022

What is the principal reason for performing the Risk Assessment?

A risk assessment was requested to support the Water Framework Directive Alien Species Group's classification of this species.

SECTION A – Organism Information and Screening	
Stage 1. Organism Information	**RESPONSE**
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	European catfish, sheatfish, Danube catfish, a.k.a. 'Wels catfish' (*Silurus glanis*) Linnaeus, 1758 This is a single taxonomic entity that can be adequately distinguished from other entities with clear external diagnostic features (Copp *et al.* (2009a).
2. If not a single taxonomic entity, can it be redefined? (if necessary, use the response box to re-define the organism and carry on)	N/A
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	Yes. Copp *et al*. (2016) used the European non-native species aquaculture risk assessment (ENSAR) to assess the risk of *S. glanis* for the U.K. The authors determined the risk to be 'Medium', with overall moderate confidence for the 'Organism' module. For the 'Infectious Agent', 'Facility', 'Pathway' and 'Socio-economic' modules, *S. glanis*, was assessed to present Moderately low, Medium, Moderately high and Moderately low risk respectively. Confidence levels of the responses ranged from 'Moderate' (Infections Agent and Facility Modules) to 'High' (Pathway and Socio-economic Modules).
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	Yes. Using the invasiveness tool FISK, Almeida *et al*. (2013) rated *S. glanis* as highly invasive in Iberia. In a calibration of FISK for England & Wales, Copp *et al*. (2009b) found *S. glanis* to pose a high risk of being invasive.
5. Where is the organism native?	Afghanistan, Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, France, Finland, Germany, Georgia, Greece, Hungary, Iran, Kazakhstan, Kirgizstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Moldova, Montenegro, Netherlands, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Sweden, Switzerland, Tadzhikistan, Turkey, Turkmenistan, Ukraine, Uzbekistan (GBNNS fact sheet

	David Hubble, 2011). The native distribution of *S. glanis* extends from Germany, east to Poland, North to Southern Sweden and down to Southern Turkey and North Iran, covering the Baltic States to Russia and the Aral Sea of Kazakhstan and Uzbekistan (as cited in Copp *et al*., 2009a) Once thought to be non-native to Flanders, Belgium, archaeological evidence dating from the Neolithic to the 12th Century suggests *S. glanis* were indeed native to Belgium, extirpated by an unknown agent, with the current population a re-introduction of a native species (Verrycken *et al*., 2007).
6. What is the global distribution of the organism (excluding Great Britain)?	The species has spread throughout Eastern and Western Europe where it may well have been native, has been recorded in South America (Cunico 2014) and was introduced to China (Froese & Pauly 2012). Portugal (Gkenas *et al*., 2015) Introductions of *S. glanis* continue to occur in Southern Europe, further increasing their invaded range (Cucherousset *et al*., 2018)
7. What is the distribution of the organism in Great Britain?	*Silurus glanis* catfish are known to be present in over 280 still waters and have been confirmed as present in a number of canal and river systems in the UK. First introduced to GB in 1854 and again in 1864 (Lever, 2009), *S. glanis* has established self-sustaining populations in many still waters, particularly in the Midlands, South East,West and North of England (Maitland, 2004) . It is not known if any sustainable populations are yet present in rivers, notably the River Trent and River Great Ouse systems, however juvenile catfish have been detected in a number of river systems and nest-guarding behaviour has been observed, (Environment Agency, unpublished data). They were introduced primarily as a sport fish for angling purposes, although some accidental introductions with consignments of native fish may have occurred, coupled with some natural dispersal from open waters (Britton *et al*., 2010). Environment Agency regulation and compliance records indicate that their popularity as a sport fish (Hickley & Chare, 2004) has led to a high level of illegal introductions.
8. Is the organism known to be invasive (i.e. threaten organisms, habitats or ecosystems) anywhere in the world?	Yes. In other European countries outside of its native range, *S. glanis* has been documented to be invasive. *Silurus glanis* are often reported to be highly invasive, but they do not spread rapidly if unassisted by deliberate introduction (Brevé *et al.,* 2014). Using the invasiveness tool FISK, Almeida *et al.* (2013) rated *S. glanis* as highly invasive in Iberia. In the calibration of FISK for England & Wales in 2009 Copp *et al.* (2009b) found *S. glanis* was found to pose a high risk of being invasive. There is some record of threat to organisms and ecosystems; numbers of wildfowl may be reduced in lakes (Carol *et al*. 2009), with Cucheroussset *et al.* (2012) observing 'beaching' behaviour of *S. glanis* to predate upon birds on land. *Silurus glanis* may also lead to a reduction in other fish species such as that seen in the Ebro in Spain, Guillerault *et al*. (2015) noted local effects on fish populations, however they found no generalised impact of *S. glanis* on fish biomass, density or community structure in French rivers. Boulêtreau *et al*. (2011) found aggregations

	of *S. glanis* in sufficient numbers to affect nutrient balance, however there is no evidence of this behaviour in GB. *Silurus glanis* have also shown adaptation to novel food sources, with Boulêtreau *et al.* (2018) finding significant predation rates (35% - 14/39 individuals) on adult Atlantic salmon *Salmo salar* using a fish-lift in France. Atlantic salmon are already subject to significant pressures, presenting concerns over their population stability. The authors conclude that the spread of *S. glanis* will impact migration of anadromous species through anthropized systems, with Guillerault *et al.* (2018) supporting this statement.

SECTION B – Detailed assessment

PROBABILITY OF ENTRY

Important instructions:

- For organisms which are already present in GB, only complete the entry section for current active pathways of entry or if relevant potential future pathways. The entry section need not be completed for organisms which have entered in the past and have no current pathways of entry.

Notes:

- Entry is defined as the movement of an organism from outside of GB into GB either into the wild or into containment.
- A pathway is defined as any means that allows the entry or spread of a non-native species.
- Examples of pathways include shipping, escape from wildlife collections, horticulture trade, pet trade, etc.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.1. How many active pathways are relevant to the potential entry of this organism? (If there are no active pathways or potential future pathways respond N/A and move to the Establishment section)	Few	High	
1.2. List relevant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 1.3 to 1.10 (copy and paste additional rows at the end of this section as necessary).	1. Aquatic trade including licensed import for recreational angling and 'hitchhikers' in legal consignments of fish 2. Illegal importation		

Pathway name: Aquatic Trade	**1. Aquatic trade including licensed import for recreational angling and 'hitchhikers' in legal consignments of fish**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 4, 9, 10, 11)	Yes – entry may occur both intentionally and accidentally	Low	It is legal to introduce into and keep *S. glanis* in inland waters with a permit (or license in the case of Scotland) under the Keeping & Introduction of Fish (England & River Esk Catchment) Regulations 2015, the Keeping & Introduction of Fish (Wales) Regulations 2015 and the Salmon & Freshwater Fisheries (Consolidation) (Scotland) Act 2003. A permit (and carriers note) is also required for suppliers of fish under the above regulations. They are a popular recreational sport fish, however better regulation and availability of *S. glanis* in GB has reduced the probability of this pathway being responsible for further entry into GB.
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	Unlikely	Medium	As previously stated, these fish are valued, increasingly popular as a recreational sport fish, and are legally available through trade (subject to necessary authorisations for introduction). *Silurus glanis* are already present in over 280 waters in England (Environment Agency, unpublished data) and are likely to be present in waters as yet undetected. Hickley & Chare (2004) note that un-permitted illegal transfer of *S. glanis* does occur (see Pathway 2.). Many angling venues are legally compliant and have appropriate permits in place, however illegal introductions have already widely distributed *S. glanis,* with nearly 70 sites known to be keeping *S. glanis* in inappropriate waters (Environment Agency, unpublished data).
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	Very likely	High	*Silurus glanis* are a commercial species, trade and movement is well established and efficient. The species is very robust, and tolerant of poor environmental conditions (Lelek, 1987). *Silurus glanis* will spawn when water temperatures exceed 18–22 °C (Copp *et al.*, 2009a), which are attainable during British summers (e.g. Hannah & Garner, 2015), these smaller fish are then more easily transferred undetected to other venues, but multiplication during transport is unlikely. Monitoring of stillwater fisheries by the Environment Agency during fisheries management activities, and specifically invasive non-native species eradication operations has detected strong evidence of successful recruitment and establishment of viable populations in permitted and non-permitted recreational and commercial stillwater fisheries, including sites in the North West, Midlands, South West and South East of England.

1.6. How likely is the organism to survive existing management practices during passage along the pathway?	Very likely	High	Very likely; *Silurus glanis* are very robust, being tolerant of poor environmental conditions e.g. low oxygen requirements (Copp *et al.,* 2009a; Danek *et al.,* 2014), so may be more tolerant of transfer.
1.7. How likely is the organism to enter GB undetected?	Unlikely	Medium	The species is already present in GB and some businesses are authorised to import this species. This, coupled with robust legislation may lower the likelihood of unregulated import as the primary issue is illegal distribution and introduction once in GB.
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	Very likely	High	*Silurus glanis* are already present in GB.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	Very likely	High	*Silurus glanis* is intentionally transported, so anthropogenic transfer of individuals is to suitable habitat. Given the number of waters where *S. glanis* are currently present, accidental transfer via permitted fish movements could occur. Additionally, some waters where *S. glanis* are present are unsuitable for their keeping, that is, they are online (with inlet and outlet) or in a flood plain, which presents a risk of *S. glanis* individuals escaping into the wild (Britton *et al*., 2010). "There are examples of inter-mixing of stocking drivers (angling, amenity and ornamental) and introduction practices (legal and illegal releases) in the dispersal of non-native fishes. The fish species most indicative in these trends (i.e. ide/golden orfe) is joined with species that have largely been introduced intentionally by legal means (e.g. bream, grass carp, common carp) and by species released illegally for angling (e.g. European catfish) or as unwanted pets (e.g. koi carp)." (Copp et al. 2010).
1.10. Estimate the overall likelihood of entry into GB based on this pathway?	Unlikely	Medium	There are a number of existing suppliers and fishery owners in England that offer *S. glanis* for introduction to fishery waters.

Pathway name: Illegal importation	**2. Illegal importation**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 4, 9, 10, 11)	Intentional	Low	Importation and subsequent introductions of *S. glanis* have been carried out for the purposes of increasing sport fishing opportunities. Some introductions have occurred at locations where current environmental legislative controls would not permit the introduction of *S. glanis* (Hickley & Chare, 2004). However, given the number of *S. glanis* already present in GB, these transfers are likely to be fish movements within GB, rather than imports from elsewhere.
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	Low	Low	The incentive to import large specimens from Europe has been reduced due to the suspension of the *S. glanis* rod-caught record by the British Record Fish Committee. However there may still be a commercial incentive to source very large fish (only available from overseas where the species naturally grows larger) in order to attract specialist anglers to certain fisheries (Hickley & Chare, 2004). There are numerous waters in which *S. glanis* have been illegally introduced and are being kept, some of which historically had temporary licences under ILFA, conditioned for removal, and will now be issued with similarly conditioned permits under the Keeping and Introduction of Fish (England and River Esk Catchment Area) Regulations 2015. Transfer of *S. glanis* individuals from these sites to new ones within the GB poses a greater risk of range expansion than those from new imports.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	Very likely	High	As above, transfer of the organism through natural means is limited, but does pose a risk where *S. glanis* are present in online waters or those liable to flooding (Britton *et al*., 2010). The principal mode of transfer is by humans, i.e. either inadvertently within consignments of other fish (Gozlan *et al*., 2010) or intentionally for angling purposes (Hickley & Chare, 2004).
1.10. Estimate the overall likelihood of entry into GB based on this pathway?	Moderately likely	Medium	Given the relative ease of obtaining *S. glanis* within GB the elaborate measures necessary to import the fish illegally seem unlikely to be taken. However, the British Record Fish Committee suspended the UK record for *S. glanis* in the year 2000 due to the suspected import of large *S. glanis* from Europe, in excess of the existing record.
1.11. Estimate the overall likelihood of entry into Europe based on all pathways (comment on the key issues that lead to this conclusion).	Likely	Medium	Much of Europe is within the native range of *S. glanis*, but their large body size has made them popular with recreational anglers in Europe, resulting in their further introduction and dispersal to some western and southern European countries outside of their native range (Cucherousset *et al*., 2018). *Silurus glanis* continue to be a popular

			species for recreational angling in GB (Britton *et al*., 2010; Hickley & Chare, 2004) so further introductions and subsequent dispersal into open systems is likely.

PROBABILITY OF ESTABLISHMENT

Important instructions:

- For organisms which are already well established in GB, only complete questions 1.15 and 1.21 then move onto the spread section.

Notes:

- Establishment is defined as the perpetuation, for the foreseeable future, of a pest within an area after entry.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in GB?	Extremely widespread	High	*S. glanis* inhabits large rivers, lakes and even coastal areas with low salinity of less than 15‰ (Copp *et al*., 2009a). However, the preferred habitat is noted to be still waters (Greenhalgh, 1999). *Silurus glanis* are legally present in over 200 recreational fisheries (Environment Agency, unpublished data) and will continue to be available in the trade for ornamental purposes and for introduction to legally compliant waters for angling purposes. There are also nearly 70 known sites (Environment Agency, unpublished data) which are inappropriate for the keeping of *S. glanis*. There is evidence that *S. glanis* have successfully reproduced in waters across the Midlands, South East and South West of England (Environment Agency, unpublished data), although recruitment success appears to be currently limited (Copp *et al*., 2009a).
1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in GB?	Moderately likely	Low	*Silurus glanis* could be eradicated from some waters, particularly in small lentic systems, where physical removal (trapping or electrofishing) or biocide use could be employed (https://humanwildlifeecology.wordpress.com/2018/04/11/wels-catfish-silurus-glanis-species-management-strategy-final-section-61/). However, should self-sustaining populations of *S. glanis* be present, such techniques may have limited success, given the species longevity and parental care facilitating reproductive success. Biocidal eradication techniques (using a rotenone based piscicide – 0.125ug/l) are known to be effective in eradicating this species from stillwaters in England (Environment Agency, unpublished data). However delivery of such a large scale strategy would require significant funding and dedicated resource, neither of which is currently available. Where *S. glanis* is found to be present in very large still waters, or lotic systems, eradication success will be very limited, if even feasible at all (Britton *et al*., 2011). Additionally, impacts on non-target species may prevent the use of piscicides (Britton *et al*., 2010). Removal of *S. glanis* propagules via rod and line has been shown to reduce catfish population size (Vejřík et al., 2019), so this method of physical removal could be employed to reduce population numbers where full

			eradication measures could not be undertaken. This method will not lead to total eradication and may only be viable in enclosed waterbodies. Socio-economic impact and acceptability factors are also of concern. While not insurmountable, there would be significant concern and opposition to such a strategy from the angling industry, with the potential for wider public concerns given the numbers of *S. glanis* that would need to be destroyed. The primary difficulty for an eradication campaign is sustainability. The species will continue to be readily available within the aquaculture trade, there are in excess of 280 sites known to contain *S. glanis*, with the potential for further introduction to other appropriate sites, so the likelihood of illegal reintroduction is high. *Silurus glanis* is already known to have been illegally introduced to a number of waters.
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?	Very likely	Medium	*Silurus glanis* are tolerant of the temperature range found in UK waters (Britton *et al.,* 2010), allowing persistence of introduced individuals. Their scaleless skin facilitates respiration via oxygen absorption and carbon dioxide secretion (Copp *et al.,* 2009a) enabling them to tolerate the reduced oxygen conditions found in many eutrophic ponds. Under suitable conditions, rapid growth (Alp *et al.*, 2011) and a broad spectrum of diet (Carol, 2009; Copp 2009; Czarnecki *et al.*, 2003; Nihal & Bora, 2004; Syvaranta *et al.,* 2009, 2010), will also aid establishment. Whilst it is noted that establishment of self-sustaining *S. glanis* populations in GB is currently limited due to temperature (Copp *et al*., 2009a), *S. glanis* have successfully reproduced in the wild. Continuing propagule pressure from introductions and reproduction, albeit limited at this time, will aid further establishment in GB.
1.23. How likely is the capacity to spread of the organism to facilitate its establishment?	Unlikely	Medium	Natural spread of *S. glanis* has been noted to be slow if unassisted (Valadou 2007, Kamangar, & Rostamzadeh 2015.) with Carol *et al.* (2007) demonstrating high site fidelity of tagged *S. glanis*. There is scope for more rapid (downstream) dispersal of *S. glanis* out of lentic systems during flood events but temperatures in the receiving lotic environment are currently limiting reproductive success.
1.24. How likely is the adaptability of the organism to facilitate its establishment?	Moderately likely	Medium	*Silurus glanis* have a highly adaptable diet (Carol *et al.*, 2009; Syvaranta *et al.*, 2010) and tolerate low water quality, which will facilitate establishment once introduced. *Silurus glanis* can also tolerate a wide temperature regime, despite optimum temperatures being >25 °C (Copp *et al*., 2009a), however they have fairly strict requirement for water temperatures to exceed 18-22 °C before spawning occurs which could limit further establishment opportunities.

1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?	Likely	Medium	Imports have occurred over many years (decades) from multiple sites across Europe. Low genetic diversity is very unlikely to limit establishment of *S. glanis*. Indeed, Triantafyllidis *et al.* (2002) recorded low genetic diversity of *S. glanis* populations in self-sustaining, native populations in Greece.
1.26. Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in GB? (If possible, specify the instances in the comments box.)	Very likely	High	*Silurus glanis* have already established invasive, self-sustaining populations in western and southern European freshwaters (Cucherousset *et al*., 2018). There is evidence to support that is has limited establishment in stillwaters in GB already (Britton *et al*., 2007; Britton *et al*., 2010; Copp *et al*., 2009a), with: young-of-the-year and juvenile *S. glanis* being recorded during Environment Agency fisheries management activities and invasive non-native species management operations in sites in the Midlands, South East and South West of England (Matt Brazier Environment Agency National Invasive Species Advisor *pers. Comm*). Current climatic conditions limit reproductive success, but predicted increasing summer temperatures are likely to facilitate their establishment (Britton *et al*., 2010).
1.27. If the organism does not establish, then how likely is it that transient populations will continue to occur? Subnote: Red-eared Terrapin, a species which cannot re- produce in GB but is established because of continual release, is an example of a transient species.	Very likely	High	Even without established breeding populations, there is a high likelihood of continued propagule pressure through introduction of *S. glanis* into stocked fisheries and persistence of existing *S. glanis* populations due to their longevity.
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).	Very likely	Medium	*Silurus glanis* has already established self-sustaining populations in lentic waters and there is anecdotal evidence of nest guarding behaviour in a major river, which suggests that there are reproducing populations in lotic waters, but no young-of-the-year *S. glanis* have been recorded to confirm this. The recent capture of a juvenile *S. glanis* from the River Trent, England, by an angler (Angling Times, 2020), may indicate reproduction in rivers is occurring, however, the origin of the specimen in question

			cannot be verified and may have been introduced. Water temperatures in a Cambridgeshire river have exceeded the minimum spawning requirements (18-22 °C) for *S. glanis* over the last 5 years, indicating some rivers already have favourable conditions for their establishment.

PROBABILITY OF SPREAD

Important notes:

- Spread is defined as the expansion of the geographical distribution of a pest within an area.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
2.1. How important is the expected spread of this organism in GB by natural means? (Please list and comment on the mechanisms for natural spread.)	Minimal	Medium	This is a territorial species, which tends to stay in the same place once established, dispersing as juveniles (Slavik *et al.,* 2007). However even though natural spread through river systems can be slow (Kamangar & Rostamzadeh, 2015), it is still an important dispersal mechanism. Natural spread of *S. glanis* from appropriate waters should be minimal, given they are required to be off-line (i.e. no inlets or outlets) and outside of the 1 in 100 year flood plain. However, there are a number of sites known to contain *S. glanis* in inappropriate waters, some of which are in the 1 in 100 year floodplain, or have inlets and outlets connected to river systems (Environment Agency, unpublished data). Such waters can increase the likelihood of further spread of *S. glanis*, via escapees during flooding events or dispersal through outflows (Davies & Britton, 2016: Fobert *et al*., 2013 Sály *et al*., 2009).
2.2. How important is the expected spread of this organism in GB by human assistance? (Please list and comment on the mechanisms for human-assisted spread.)	Major	High	The primary vector for the spread of *S. glanis* is by humans via intentional (and some unintentional) transfer to support recreational sport fishing (Hickley & Chare, 2004, Gozlan *et al*., 2010). The focus of creating additional or more diverse fishing opportunities may overlook any adverse consequences of inappropriate introductions of non-native fish species and the facilitation of their spread.
2.3. Within GB, how difficult would it be to contain the organism?	Very difficult	Moderate	It will be extremely difficult to contain *S. glanis* as it is already legally present in UK fisheries and is a popular heavyweight sports angling fish. The species will continue to be readily available within the aquatic trade. The large number of waters known to contain *S. glanis*, whether they be legally kept or otherwise, pose a potential source for further introduction to other appropriate sites, so the likelihood of illegal spread is high (Hickley & Chare, 2004); this was certainly the case on the Ebro in Spain (Miranda *et al.,* 2010).
2.4. Based on the answers	Most freshwater	Low	All canals, slow rivers, drain systems, ponds and lakes with areas where water temperatures

to questions on the potential for establishment and spread in GB, define the area endangered by the organism. [text]	that is still or slow flowing		approach 20 °C+ for a sufficient period to permit spawning, will be capable of supporting sustainable populations; they are a long lived species therefore these temperatures need not need to be achieved annually for establishment to occur. Whilst natural spread within open systems may be slow, human-mediated spread can be assist in the further dispersal of *S. glanis*, increasing the potential for establishment and further colonisation in GB.
2.5. What proportion (%) of the area/habitat suitable for establishment, if any, has already been colonised by the organism?	1 to 10%	Low	Difficult to estimate, however based on the 5235 lakes or ponds in the Biological Action Plans for England, around 8% of lentic waters are colonised. Although *S. glanis* are known in rivers and canals there is no good estimate of the area inhabited yet. Copp *et al*. (2010) report that 7.54% of England occupied, but this is based on 10 x 10 km grids.
2.6. What proportion of the area/habitat suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	10-20%	Low	At the current rate of introduction and given a relatively slow natural dispersal in rivers, such as that seen in France (Valadou, 2007), a proportion of between 10 and 20% is predicted.
2.7. What other timeframe would be appropriate to estimate any significant further spread of the organism in Great Britain? (Please comment on why this timeframe is chosen.)	50 years,	Low	*Silurus glanis* have been present in the UK since the mid-19th century (Lever 2009; Hickley & Chare 2004), but have not spread rapidly until recently. The recent appearance in river systems may herald a change from chiefly human-assisted spread to natural dispersal and establishment, like that seen in Europe. Higher water temperatures would favour establishment (Hilge 1985, Brevé *et al.,* 2014, Britton *et al.,* 2010). The suggested timeframe is based on the spread of *S. glanis* in Spain after introduction in 1974 across the Ebro river basin to the Tajo, Ter and Llobregat river basins in 2006 (Benejam *et al.,* 2007) and the increasing propensity for the introduction of *S. glanis* to new waters .
2.8. In this timeframe what proportion of the endangered area/habitat (including any currently occupied areas/habitats) is likely to have been invaded by this organism?	20 – 60%	Low	Much of the suitable river and canal habitat is interconnected, allowing spread by juveniles (Slavik *et al.,* 2007). Current legislative regulation has not totally prevented the introduction and keeping of *S. glanis* in unsuitable waters to date. Perhaps the deciding limit will be the extent of their popularity with anglers, something that has not yet waned (Hickley & Chare, 2004). The broad estimate reflects this uncertainty, as does the Confidence score, but proportion of habitat invaded is likely to be towards the lower estimate.

2.9. Estimate the overall potential for future spread for this organism in Great Britain (using the comment box to indicate any key issues).	Moderate	Medium	Not all freshwaters are suitable habitat as some will be fast flowing and still waters that are not easily accessible are unlikely to have *S. glanis* introduced to them. However, human-mediated spread is likely to continue and further disperse *S. glanis* (Britton *et al*., 2010; Hickley & Chare, 2004).

PROBABILITY OF IMPACT

Important instructions:

- When assessing potential future impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.

Notes:

- Where one type of impact may affect another (e.g. disease may also cause economic impact) the assessor should try to separate the effects (e.g. in this case note the economic impact of disease in the response and comments of the disease question, but do not include them in the economic section).

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range (excluding GB), including the cost of any current management?	Minor	Low	*Silurus glanis* are generally regarded as an economic asset being important for aquaculture and as a sports fish (Alp *et al.*, 2011; Copp *et al.,* 2009a). This however disregards the economic cost of any environmental degradation that could be linked to the presence of *S. glanis*, loss of wildfowl or reduced biodiversity (Carol *et al.,* 2009), which has not been estimated for GB or any mitigation/ management costs.
2.11. How great is the economic cost of the organism currently in GB excluding management costs (include any past costs in your response)?	Minimal	Low	There is currently no known economic cost.
2.12. How great is the economic cost of the organism likely to be in the future in GB excluding management costs?	Minor	Low	There is unlikely to be a significant economic cost unless *S. glanis* thrive to the extent that they deplete the stocks of other fish favoured by anglers through either predation or competition. *Silurus glanis* captures have been reported as a nuisance by recreational salmonid anglers and their presence 'unwelcomed' (Brown, 2012), which could lead to a loss of ecosystem services. It is possible that the presence of *S. glanis* may be shown to reduce biodiversity in environmentally sensitive habitats in the UK which it may be introduced to such as lakes within SSSIs. The economic cost in that case would have to be measured in terms of reduction in amenity use associated with reduced visitor numbers.

2.13. How great are the economic costs associated with managing this organism currently in GB (include any past costs in your response)?	Minor	Low	Known sites containing this species are regulated under the aforementioned regulations (KIF Regs.). However, there is currently no active management programme in GB to contain and control this species, other than enforcement of the KIF Regs. and ad hoc facilitation of *S. glanis* removal from inappropriate waters to those permitted for the keeping of *S. glanis*.
2.14. How great are the economic costs associated with managing this organism likely to be in the future in GB?	Moderate	Low	If the environmental risk posed by *S. glanis* is thought to justify management, then the cost would be high. *S. glanis* is difficult to eradicate by conventional scientific techniques (Vidal 2007). However action such as treating entire lakes with piscicide could only be justified with strong evidence of environmental harm caused by *S. glanis*. There would be significant concern and opposition to such a strategy from the angling industry, with the potential for wider public concerns given the number of *S. glanis* that would need to be destroyed. However, the primary factor that renders this strategy 'unmanageable' is sustainability. *Silurus glanis* is known to be present in over 280 waters, with the potential for further introduction to other appropriate sites, so the likelihood of illegal reintroduction is exceptionally high (Hickley & Chare, 2004). Relocation of *S. glanis* from unsuitable waters to those where keeping is permitted is likely to incur on-going costs and may reach a point where a lack of suitable receiving waters prevents further relocations.
2.15. How important is environmental harm caused by the organism within its existing geographic range?	Moderate	Medium	*Silurus glanis* has had significant impacts on native species (Sicuro *et al*., 2016), with Castaldelli *et al*. (2013) listing *Alburnus* sp., *Scardinius* sp. and tench *Tinca tinca* being impacted and even local extinctions in the Po River Basin, Italy. *T. tinca* is native to GB, as are species in both of the Genera listed. The same article also states that Northern pike (*Esox lucius*) and perch (*Perca fluviatilis*) populations have become greatly reduced/ rare in the presence of *S. glanis*, impacting recreational and professional angling. *S. glanis* is a known predator of crayfish (*cf.* Soto *et al.,* 2013; Czarnecki *et al*., 2003), which could have implications for the already threatened native crayfish, the white clawed crayfish *Austropotomobius pallipes*. On the other hand, *S. glanis* does not always become the voracious and dominant top predator in a system (Syväranta *et al.,* 2010), and there is a lack of evidence of environmental harm from the Ebro system where unconfirmed reports suggest that this has happened. There is evidence that the presence of large *S. glanis* not only discourages water birds, but large specimens consume them (Carol, 2009). *Silurus glanis* will certainly consume anadromous species including the already pressured Atlantic salmon *Salmo salar* (Cucherousset & Olden 2011; Cucherousset *et al*., 2012, Boulêtreau *et al.,* 2018)

			in addition to common carp *Cyprinus carpio* and birds (Carol *et al.,* 2009), so it has the potential to impact economically important fish stocks. Bevacqua *et al*. (2011) suggest that *S. glanis* may have a negative impact on eels but offer no support for this other than knowing that *S. glanis* will eat eels (a UK BAP species, listed as threatened/ declining and Critically Endangered on the IUCN Red List) with juvenile *S. glanis* competing with them for food. However, in France no widespread damage to eel stocks has been reported to be attributed to *S. glanis* (Guillerault *et al.,* 2015), but the authors did acknowledge that *S. glanis* 'may in a few cases impact fish communities or populations'. *Silurus glanis* introductions are also a potential source for disease and parasite introductions, which may impact native species (Reading *et al*., 2012; Copp *et al.*, 2009a). Syväranta *et al.*(2009) did however, demonstrate the contribution of anadromous fish species, using allis shad (*Alosa alosa*) as a model sp., to the diet of *S. glanis*, where they found shad constituted a significant proportion to their diet (mean contribution range: 53%–65%). This is particularly important given the conservation status of *A. alosa*. It is of note that Copp *et al*. (2009) suggest that virtually all aspects of introduced *S. glanis* environmental biology requires further work, particularly the potential for impact on food webs. This is especially true of *S. glanis* populations in GB, of which there is a paucity of studies.
2.16. How important is the impact of the organism on biodiversity (e.g. decline in native species, changes in native species communities, hybridisation) currently in GB (include any past impact in your response)?	Minimal	Low	*Silurus glanis* feed mainly at night (Boujard, 1995) so often go unseen making their presence and impacts difficult to assess. Current effects on biodiversity are also unclear. *Silurus glanis* are capable of very rapid growth in favourable conditions (Horoszewicz & Backiel, 2003) although in GB growth rates are likely to be lower (Britton *et al.,* 2007). Even so, *S. glanis* are being caught in GB at weights of over 60kg. These fish may well be being maintained by baits and ground baits fed by anglers and fisheries owners. Impacts are more likely to be seen outside permitted fisheries, in the lakes and rivers where *S. glanis* have been illegally introduced. Although there have been no reports of direct impacts on biodiversity these large rapidly growing fish are likely to alter natural communities. In the first year they may rely on invertebrates but after that the main food is likely to be fish (Nihal & Bora 2004), except where crayfish are available (Carol *et al.,* 2009; Czarnecki *et al.,* 2003; Martino *et al*., 2011). Although the size of fish consumed is smaller than might be expected from the size of the catfishes mouth, *S. glanis* are capable of exerting sufficient pressure

			on roach populations to prevent them reaching refuge size while bream populations were unaffected (Wysujack & Mehner, 2005).. However, it is worth noting that the study by Wysujack & Mehner (2005) was based on relatively small *S. glanis* individuals (predominantly <80 cm T_L). In France, following a survey, there was a feeling that zander, pike and tench populations had been affected by the introduction of *S. glanis* (Valadou, 2007). Further information is required on GB-specific *S. glanis* populations, their interactions with native species and their impacts and how such impacts may change under climate change scenarios. Hybridization will not be a problem as there are no other members of the genus in GB.
2.17. How important is the impact of the organism on biodiversity likely to be in the future in GB?	Moderate	Low	The likely impact on biodiversity is unclear. As outlined in the previous answer it is likely that there will be an effect, but the magnitude and significance of the effect in GB is unknown. Increasing propagule pressure, facilitated by more favourable climatic conditions for *S. glanis* reproduction (Britton *et al*., 2010) and the continuing propensity to introduce individuals could lead to increasing adverse effects on native biota.
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions) caused by the organism currently in GB (include any past impact in your response)?	Minimal	Low	It is likely that *S. glanis* will disrupt trophic interactions, however the consequences are unclear as it is very likely to consume other invasive non-native species such as signal crayfish and zander, which are already altering trophic interactions in native systems. Nutrient cycling in still waters may have been affected. Bream is one of the main fish species responsible for sediment re-suspension and consequent nutrient cycle changes; this species is poorly controlled by *S. glanis* (Wysujack & Mehner, 2005), and preferential predation on other species could reduce competition, encouraging growth in bream numbers which is likely to prolong the pre-existing nutrient cycle disruption. Nutrient cycling in rivers is also unlikely to have been affected significantly as populations of *S. glanis* are still low. However if large aggregations of *S. glanis* develop in rivers there is a chance that they will cause significant nutrient hotspots to occur (Boulêtreau *et al.,* 2011), though the effects of these hotspots may not be widespread.

			Confidence is low, due to lack of GB specific studies, so impact in GB is unknown.
2.19. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions) caused by the organism likely to be in GB in the future?	Minor	Low	As mentioned in response to the previous question, if large aggregations of *S. glanis* develop in rivers there is a chance that they will cause significant nutrient hotspots to occur (Boulêtreau *et al.,* 2011), however this may only have a very localised effect. When established in a river, *S. glanis* can be a significant part of the fish biomass: on the lower Oder river in Germany Wolter & Freyhof (2004) found that *S. glanis* were only 0.35% of the numbers caught but 10.33% of the fish biomass. Silver and common bream were the only species with higher fish biomass.
2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism currently in GB?	Minor	Low	There is as yet no direct evidence of *S. glanis* causing decline in conservation status or WFD classification.
2.21. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism likely to be in the future in GB?	Moderate	Low	The introduction *S. glanis* for sport fishing is ongoing, coupled with predicted climate change scenarios, which would facilitate reproductive activity, propagule pressure is likely to increase, in turn increasing the ability of *S. glanis* to establish and become invasive (Britton *et al*., 2010). This could lead to a decline in conservation status of waterbodies, particularly those with designations for sensitive species (*c.f.* Carol *et al*., 2009). Should *S. glanis* establish invasive populations in GB, exactly how they will impact native fauna and ecosystems is not known, therefore Confidence response is low.
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their genetic nature and making their economic, environmental or social effects more serious?	Minimal	High	The only other European catfish *Silurus. aristotelis* is not native or present in GB. Genetic transfer is therefore not a risk in GB.
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by	Minor	Medium	*Silurus glanis* is important as a farmed fish in Europe and known to host a number of diseases and parasites (See Section 2.24 for details), one of which, the vibrio bacteria (Farkas & Malik, 1986). This might conceivably pose a threat to human health, but this is considered very unlikely. The lack of published

the organism within its existing geographic range?			material means it is difficult to foresee what social or other harm might be caused by *S. glanis* populations. Loss of recreational angling activities may occur as *S. glanis* can be regarded as an undesirable species by some anglers. This could have direct implications economically, through loss of ticket sales, etc., but it is likely to be a very small percentage of anglers who take this view.
2.24. How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	Moderate	High	*Silurus glanis* is host to a number of parasites and diseases, from tapeworms (De Chambrier *et al.,* 2003) to ranavirus (Duffus *et al.,* 2015), sheatfish virus (Mavian *et al.,* 2012), vibro bacteria (Farkas & Malik, 1986), monogenoideans (Galli *et al.,* 2003, Gallina *et al.,* 2009), skin ectoparasites (Nedic *et al.,* 2014), *Thaparocleidus vistulensis, Camallanus lacustris, Diplostomum* spp. *Argulus foliaceus, Trypanosoma* spp.,*Ergasilus sieboldi* (Reading *et al.,* 2012) and Spring Viraemia of Carp (SVC) (Copp *et al.,* 2009a) In their review Copp *et al.,* (2009a) list over 60 parasites of *S. glanis*, but of particular importance is that the authors of this study state the movement of *S. glanis* may introduce Spring Viremia of Carp (SVC) to new regions. Spring Viremia of Carp is a notifiable disease under The Aquatic Animal Health (E&W) Regulations 2009, with outbreaks subject to statutory control in GB. SVC can affect the commercially important *C. carpio,* with outbreaks causing significant economic losses (Taylor *et al*., 2013). Additionally, *Ergasilus sieboldi* is an important fish pathogen and the European Sheatfish Virus (ESV) causes high mortality in pike (Mavian *et al*., 2012). There is also a potential for *S. glanis* to transmit the ranavirus ECV to pike (Duffus *et al*. 2015)) There is some reference in the literature to Edwardsiellosis (Mohaty & Sahoo, 2007) and systemic amoebiasis (Nash, Nash & Schlotfeldt, 1988), but there is no evidence to show these have been present in released populations.
2.25. How important might other impacts not already covered by previous questions be resulting from introduction of the organism? (specify in the comment box)	Minor	Low	In the most serious case, *S glanis* might dominate the waterways and lakes of GB in the same way as it has done previously in the Ebro basin, Spain. For this to occur, summer water temperatures would need to exceed 20 °C for sufficient periods to facilitate breeding and rapid growth. Britton *et al.* (2010) ranked *S. glanis* along with carp as the species (of angling interest) most likely to benefit from climate warming in England and Wales. The current annual period during which temperatures are above 15 °C appears to allow *S. glanis* to maintain itself (Wysujack & Mehner, 2005), but not to grow to the sizes achieved in Spain and Italy. Copp *et al.* (2009a) mention food availability as another factor contributing to growth. With crayfish noted as a favoured food of *S. glanis*

			(Carol *et al.,* 2009; Czarnecki, Andrzejewski, & Mastyñski, 2003; Martino *et al.,* 2011; Valadou, 2007), the increasing abundance of the invasive signal crayfish *Pacifastacus leniusculus* populations in GB could also facilitate *S. glanis* establishment. However, there is a paucity of GB-specific research on the diet and ecology of *S. glanis* so specific impacts are unquantified as yet. Depredation of wildfowl by *S. glanis* (Carol *et al*., 2009; Cucherousset *et al*., 2012), particularly at locations with designations for avian fauna could be deemed to be significant, with Carol *et al*., (2009) noting the abundance of waterbirds, particularly anatids, significantly lower in reservoirs where *S. glanis* were present.
2.26. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in GB?	Minor	Low	These large fast growing fish reach sexual maturity at lengths just over 80 cm (Alp *et al*., 2004). It is a nest guarding species (Copp *et al*., 2009a) so *S. glanis* may be subject to less predation pressure than native species. Copp *et al*. (2009a) also suggested that *S.* glanis were unlikely to exert pressure on native fish but these impacts may be accentuated by other anthropogenic-mediated changes in the environment. This is broadly supported by the findings of Guillerault et al. (2015) who revealed that although local impacts may have occurred, there was no generalised impact of *S. glanis* on fish biomass, density, or community structure in French rivers. There are published studies which suggest large impacts could occur, such as disruption of marine/freshwater pathways though consumption of anadromous species (Syväranta *et al*., 2009). Syväranta *et al*. (2010) noted that *S. glanis* were not an efficient top predator, however their impacts on foodwebs were as yet unclear. This view is echoed by Britton *et al*. (2010). Leprieur *et al*. (2009) warn against equating a lack of data with a conclusion of 'no impact', which is particularly pertinent in this assessment, given the lack of GB-specific studies on almost every aspect of *S. glanis* biology.
2.27. Indicate any parts of GB where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible). [text + map if possible]	Midlands and Southern England	Medium	Given the majority of lentic *S. glanis* populations and riverine records are within this geographic range, the escape and further establishment of this species is most likely to occur in these locations. That said, current climatic conditions in most parts of GB will are favorable for the persistence of introduced *S. glanis*.

RISK SUMMARIES			
SUMMARY	**RESPONSE**	**CONFIDENCE**	**COMMENT**
Summarise Entry	Likely	Medium	*Silurus glanis* are already present in G.B., new entry is closely regulated, but illegal translocations and introductions have occurred, but quantifying the number of individual *S. glanis* arriving through these pathways is difficult given the nature of them.
Summarise Establishment	Very Likely	Medium	*Silurus glanis* are already established in lentic waters, including those within a floodplain, additionally a number of major rivers in GB are known to contain *S. glanis* individuals. However, no substantial evidence of self-sustaining populations in open systems is documented as yet. Some riverine water temperatures already exceed the minimum requirement for spawning in *S. glanis*, with predicted future climate scenarios likely to facilitate reproductive success. Lack of GB-specific research on the reproductive success of *S. glanis* is indicated by Confidence score.
Summarise Spread	Moderate	Medium	Spread is likely to continue most rapidly through intentional (and some unintentional) introductions (Britton *et al*., 2010) but as *S. glanis* are in a number of floodplain waters and open systems, slow natural spread will also take place.
Summarise Impact	Moderate	Low	Studies on the impact of introduced *S. glanis* in other European countries has highlighted the potential for impacts on GB fauna, with Copp *et al*. (2009a) listing the potential impacts of *S. glanis* in its introduced European range to include disease transmission, predation on native species and possibly the modification of food web structure in some regions. The authors do however, note that *S. glanis* is unlikely to exert trophic pressure on native species, except where other human impacts are already in force. However, potential impacts may be realised by 'even relatively small increases in water temperature' which are likely to facilitate *S. glanis* establishment of invasive populations in GB (Britton *et al*, 2010), impacts which may be accentuated by human-mediated environmental changes (Copp *et al*., 2009), presenting a risk to modified waterbodies. There is currently a lack of any GB-specific research into the impact of *S. glanis* on native fauna, with the disease status of GB *S. glanis* individuals poorly studied (Reading *et al*., 2011), which is reflected by the Confidence score, but Hickley & Chare (2004) note the main concern is if *S. glanis* escape to open systems because juvenile *S. glanis* can carry the

			EU notifiable disease Spring Viremia of Carp.
Conclusion of the risk assessment	Moderate	Low	*Silurus glanis* are large bodied, grow rapidly, although less rapidly in GB than in countries with warmer summers (Britton *et al*., 2007). They have a broad diet and are tolerant of a range of environmental conditions, however they usually consume much smaller prey than their mouth size would suggest. They are nocturnal and preferentially feed on other nocturnal species, including invasive species such as crayfish and zander. They tend to be territorial and have a slow natural rate of dispersal. They have been present in GB for >100 years, but have become increasingly widespread through intentional (illegal and legal) introductions and dispersal from online water bodies, or those in a flood plain (Britton *et al*., 2010). Introductions of parasites and diseases associated with *S. glanis* are unlikely to be detected until established or outbreaks occur as *S. glanis* can only be legally introduced to mandatory fully enclosed waters (outside of the floodplain), where fish-health checks are not mandatory (but still advised). Furthermore, illegal movements will not be subject to health checks. Hybridisation with native species is not an issue as there are no native Siliuriformes species in GB. The presence of such a large predator is likely to alter natural communities, but evidence gaps remain around exact impacts on our aquatic systems and the native species therein. Impacts are likely to be moderated by the limited natural dispersal exhibited by *S. glanis*, but loss of ecosystem services and or socio-economic impacts could be realised, particularly in modified systems.Copp *et al*. (2009a) suggest that *S. glanis* is more of an opportunistic scavenger than a voracious predator, however Vejřík *et al*., (2019) describe them as an apex predator, indicating there is still a degree of ambiguity as to the impacts they may impose on a system. . In addition, waterfowl could be affected by the presence of *S. glanis* and this could be a major impact on sensitive sites or those designated for their wildlife Confidence is low in this conclusion as further research on the biology and effects of *S. glanis* on ecosystems is required, specifically focussing on GB populations and the interaction of *S. glanis* with native fauna (Copp *et al*., 2009a).

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**CONFIDENCE**	**COMMENT**
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism? [text]	Increased water temperatures. Increased flooding/ spate events.	Medium	Optimal temperatures for growth of *S. glanis* are between 25–28 °C (Hilge 1985), suggesting increasing water temperatures are likely to facilitate the growth of *S. glanis* individuals already present in GB. Britton *et al*. (2010) state that a 2 °C increase in mean air temperature may still slightly constrain *S. glanis* reproduction in GB, but an increase of 3 and 5 °C will enhance their ability to reproduce and suggest that relatively small increases in water temperatures are likely to enhance their establishment and invasion. *Silurus glanis* become less active when water temperatures are < 10°C (Copp, 2009a). Increased water temperatures may lead to an increase in *S. glanis* activity and therefore increased potential for negative effects on aquatic ecosystems through predation. Furthermore, changes in the magnitude, frequency and duration of flooding events, associated with climate change scenarios are likely to assist the further dispersal and invasion success of non-native species (Forbert *et al*., 2013), including *S. glanis*, particularly given the number of populations with direct connections to the lotic environment, or within a flood plain.
3.2. What is the likely timeframe for such changes?	50 years	Low	Climate change scenarios for GB are likely to facilitate *S. glanis* establishment and subsequent invasion success (e.g. Britton *et al.,* 2010; Fobert *et al*., 2013). Analysis of long-term temperature increases may not be particularly useful in forecasting the spread and potential impacts associated with *S. glanis*, but the probability of any year being more favourable to *S. glanis* will increase over time as climate change progresses and mean annual temperatures increase. Successful reproduction is already occurring under current climate conditions, opportunities to breed are likely to increase and may result in annual breeding events. Increases of summer temperatures in GB have been predicted to be from 0.9 to 5.4 °C by 2070, under a ‘high emissions’ scenario (Meteorological Office, 2019), temperatures noted by Britton *et al*. to be of increased benefit to *S. glanis* establishment.
3.3. What aspects of the	Dispersal; Habitat	Low	Impact is likely to increase under current climate change scenarios, with increased

risk assessment are most likely to change as a result of climate change? [text]	availability & Impact.		reproductive opportunities, increased growth rates and elevated risk of flooding events and frequency, all of which can promote dispersal opportunities with a concomitant increase of impacts on native biota.

ADDITIONAL QUESTIONS – RESEARCH

QUESTION	RESPONSE	CONFIDENCE	COMMENT
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.			The main research needed is into the effects of *S. glanis* on broader aquatic ecosystems from a GB-specific perspective. Impacts on fish are assumed to be low under current climatic conditions, given the observations in Spain and France, however we are uncertain of this and do not know to what extent invertebrate and avian populations will be affected. Reproduction, growth, and diet analysis of GB *S. glanis* populations will expand our knowledge of this species and assist in assessing any potential future impacts in GB; information that is still lacking (*c.f.* Copp *et al.,* 2009a).

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