Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication 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.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks 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.
- Risk assessments 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 decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@fera.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism:	***Xenopus laevis* - African clawed frog**	
	Objectives:	Assess the risks associated with this species in GB	
	Version:	FINAL 04/04/11	
N	**QUESTION**	**RESPONSE**	**COMMENT**
1	What is the reason for performing the Risk Assessment?		Requested by the GB Non-native Species Programme Board.
2	What is the Risk Assessment area?	GB	As the only means by which *Xenopus laevis* can reach the wild in the UK is by the release or escape of captive animals, this species has the potential to turn up anywhere in Great Britain or Northern Ireland. However, established breeding populations are only known in the UK from two areas, south Wales and Lincolnshire (Beebee & Griffiths 2000), and it has never spread widely in this country.
3	Does a relevant earlier Risk Assessment exist?	NO OR UNKNOWN (Go to 5)	
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?		
A	**Stage 2: Organism Risk Assessment SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Xenopus laevis* . Pipidae, Anura (Deuchar 1975; Frost 2002;). Amphibian, animal. Common name: African clawed frog. Several other *Xenopus* species exist and there are numerous subspecies of *Xenopus laevis* (Kobel *et al.* 1996). The taxonomy of this genus is under revision, although *Xenopus laevis laevis* appears to be the only taxon involved in widespread culture and releases into the wild.
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	YES (Go to 9)	Invasive populations exist in many areas of the world (Lever 2003; Measey 2006; Tinsley & McCoid 1996), for example in the USA (McCoid & Fritts 1980), South America (Lobos & Measey 2002; Lobos & Jaksic 2005), Java, Ascension Island and in Europe. In Europe, large invasive populations exist in France (Duguet & Melki 2003; Fouquet 2001; 2002; Fouquet & Measey 2006; Thirion & Fouquet 2003), especially in the west of that country, and in Italy (Lillo *et al.* 2005). Evidence that this species threatens any other species by feeding or competition is scanty, although Lafferty & Page (1997) discuss the predation by *Xenopus* of a rare brackish water goby in North America. Nonetheless, authenticated accounts of negative impacts caused by *Xenopus* are extremely rare and most concerns appear to be theoretical or anecdotal. Lobos and Jaksic (2005), for example, note the rapid spread of *Xenopus* in Chile and comment that, while they have no direct evidence of predation on native amphibians, they have concerns about such predation, as well as disease spread, possible competition and habitat modification. It appears that *Xenopus* may increase the turbidity and amount of sediment in the water where it is found, due to its feeding activity on the bottom, although the severity of this, and how it may affect other organisms, depends on population numbers. *Xenopus* can also be toxic to some predators as a new family of peptides (Xenoxins) has been found in these frogs that are homologous to the neurotoxins and cytotoxins of snake venom (Measey 2006). It is not known how these toxins actually affect predators, however, and they have been experimentally shown to have low general toxicity to mice (Kreil 1996). The most serious potential consequence of the introduction and spread of *Xenopus laevis* is that it is probably a carrier of the chytrid fungus, *Batrachochytrium dendrobatidis* , that has been a contributory factor in amphibian declines in various parts of the world (although in the UK the Lincolnshire *Xenopus* colony has proved negative for this). In addition, it has recently been suggested that Xenopus may carry other pathogens, such as *Ranavirus* , that can negatively impact amphibian populations (Robert *et al.* 2007).

8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?		*Xenopus laevis* is an adaptable species that can survive in a wide range of water conditions - e.g. up to 40% seawater, in water ranging from pH 5 - 9, in temperatures from 2 - 35 degrees C and at various altitudes. Therefore, it should in theory be able to survive across most of the UK (although this does not imply successful breeding would occur). *Xenopus* lives in streams and ponds, including man-made ponds and ditches, but avoids larger rivers and water bodies with large predatory fish. The largest numbers are found in eutrophic waters where the adults can feed on their own larvae as well as on planktonic algae. *Xenopus* is able to aestivate if ponds dry out. This species can become mature in 8 months under ideal conditions, but it is also a very long lived species, surviving for up to 20 years. The native range in South Africa has a Mediterranean climate and it is in such climatic areas elsewhere in the world that the invasive qualities of this species are most evident, much more so than in temperate climates such as the UK. (Tinsley & Kobel 1986).
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	It is impossible to control or contain deliberate releases or accidental escapes. However, as it is no longer used for pregnancy testing the extensive husbandry of *Xenopus* throughout the UK has declined (although this species is still as extremely important laboratory animal). In addition, pet keepers are also becoming more aware of the potential damage caused by deliberate releases. Consequently, there is now far less likelihood of further introductions or escapes into the wild in the UK.
10	Is the organism widely distributed in the Risk Assessment area?	NO (Go to 11)	The first recorded breeding population of *Xenopus laevis* in the UK was discovered in 1962 on the Isle of Wight (half way down a landslip cliff), but this population is now probably extinct as the relevant part of the cliff has fallen into the sea and no longer exists. However, there has been a recent report of *Xenopus* from a pond on top of this cliff, possibly a garden pond, but no more details are available (D. Bird *pers.com.*). Established breeding populations are currently only known in the UK from two areas, south Wales and Lincolnshire (Beebee & Griffiths 2000). The south Wales population, which was first recorded in 1979 (Tinsley & McCoid 1996), is the largest and has been well studied (Measey 1998a; 1998b; 1998c; 2001; Measey & Tinsley 1998). There were formally two populations in south Wales - the continued existence of one is now uncertain, while the other is thought to have declined significantly since the 1980s. No information is available about the current status of the Lincolnshire population. This species was also reported in 1987 and 1990 from two ponds to the southeast of London, although these do not appear to have survived (D. Bird *pers.com.*). Occasional adult *Xenopus* have been reported by river authority fish population monitors in the southwest of England, but no established populations have been found (Tinsley & McCoid 1996).
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?	YES (Go to 12)	There are numerous ponds, lakes and other water bodies that are potentially suitable for the survival of this species in the UK. *Xenopus* is a hardy adaptable species and can tolerate a wide range of conditions in the UK.
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?	NO (Go to 14)	Not relevant to this species.
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		
14	Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment area or sufficiently similar for the organism to survive and thrive?	YES (Go to 16)	The UK climate is mild enough to allow survival and limited breeding of this species. However, *Xenopus laevis* originates from a Mediterranean climate (South Africa), so the UK climate does not permit this species to thrive, i.e. to increase in numbers or to spread rapidly, or become invasive.
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?	YES (Go to 16)	Yes, *Xenopus* is widely bred in protected conditions, although these are invariably controlled conditions.
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?	YES (Go to 17)	*Xenopus* has been widely spread as a result of man's activities (see response to Question 7).

17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	*Xenopus* was originally used for pregnancy testing (Shapiro 1936; Shapiro & Zwarenstein 1934), and as a laboratory animal (Gurdon 1996), and was later widely kept as a pet (Reed 2005). Its subsequent spread by humans was via deliberate releases into the wild or escapes. It is no longer used for pregnancy testing and although it is still a very important laboratory animal, as noted in Question 9, escape from such facilities is inevitably far more difficult nowadays. Pet keepers are also becoming more responsible, so there is now less likelihood of spread by these means. Although aquatic, *Xenopus* can spread overland in mild, wet weather (in a similar manner to eels), this appears to occur more often in warmer, especially Mediterranean, climates. In suitable areas of Chile, for example, *Xenopus* spreads at 3.9 to 5.4 km per year (Lobos & Jaksic 2005). In contrast, natural spread in the UK appears to have been very slow or non-existent, although any future warming of the climate may alter this situation.
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?	YES OR UNCERTAIN (Go to 19)	Unlikely through feeding or competition (Avila & Frye 1978; De Bruyn *et al* 1996; Frye & Avila 1979; Scoonbee *et al.* 1992). *Xenopus* is adapted to feeding in muddy conditions (Elepfandt 1996; Freitag *et al.* 1995) so large numbers (which are unlikely to build up in the UK) may cause disturbance and increased turbidity in pond bottoms. The spread of the chytrid fungus to native amphibians by introduced species such as *Xenopus laevis* may be a much more serious issue (Johnson & Speare 2003; Parker *et al.* 2002; Fisher & Garner 2007), although to date this pathogen has primarily caused the most severe problems for stream dwelling, tropical montane amphibians (where no *Xenopus* have been present) - particularly where such species are already subjected to other environmental stresses caused by habitat changes or airborne agro-chemical pollution. However, the potential for environmental harm due to chytrid infection (spread by *Xenopus* or otherwise) of native UK amphibians has been taken seriously and a nationwide study is therefore already underway (Zoological Society of London 2008).
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B	Since there is an unknown, but potentially serious, risk to native amphibians due to the possibility of *Xenopus laevis* spreading chytrid fungus (the fungal pathogen *Batrachochytrium dendrobatidis*) in the UK, a detailed risk assessment has been undertaken. A study into this problem, as part of a nationwide survey of chytrid infection in amphibians, is already underway in the UK (Zoological Society of London 2008). It is unlikely that this species presents any other major risks to the Risk Assessment area under current conditions.
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.		

B	SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences			
	Probability of Entry	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	very few - 0	LOW - 0	The only entry pathway (Kraus 2003) is via the international pet and laboratory trades and the subsequent deliberate release by humans of unwanted pet frogs or, occasionally, their escape into the wild.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.	Deliberate or accidental release into the wild		This is the only way by which *Xenopus laevis* can reach the wild in the UK.
1.3	How likely is the organism to be associated with the pathway at origin?	very likely - 4	LOW - 0	*Xenopus laevis* is widely bred in captivity and this is now a more important source of animals for the pet and laboratory trades than the importation of wild animals from Africa.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	moderately likely - 2	MEDIUM -1	The exact numbers of this species that are, or have been, bred and traded nationally and internationally are unknown.
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	MEDIUM -1	The care, captive breeding and transport of *Xenopus* are all now well understood (Gurdon 1996; Reed 2005), and this species is also very hardy, so the organism is highly likely to survive any cultivation or commercial practices.
1.6	How likely is the organism to survive or remain undetected by existing measures?	likely - 3	MEDIUM -1	*Xenopus laevis* is aquatic and inconspicuous and, unless specifically searched for or accidentally caught, can remain undetected for long periods.
1.7	How likely is the organism to survive during transport /storage?	likely - 3	LOW - 0	Transport of this species is part of a deliberate trade, rather than being accidental, so it is very much in the commercial interests of the parties involved to ensure maximum survival of the animals during shipping.
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	unlikely - 1	MEDIUM -1	Unlikely as this species requires specific conditions in order to reproduce and must also pass through a prolonged larval stage (Tinsley & Kobel 1996; Tinsley *et al.* 1996).
1.9	What is the volume of movement along the pathway?	minor - 1	LOW - 0	The numbers of this species that are bred and traded nationally and internationally are unknown. In addition, many laboratories can breed their own supply of *Xenopus laevis* .
1.10	How frequent is movement along the pathway?	occasionally - 2	MEDIUM -1	Not known.
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	limited - 1	MEDIUM -1	Current distribution (and potential for spread) of *Xenopus laevis* within the Risk Assessment area is very limited. Education and publicity appear to be reducing the rate at which further releases will occur.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	moderately likely - 2	MEDIUM -1	Unknown - it is likely that humans would only deliberately release captive *Xenopus laevis* into the wild during the most suitable (warmer) months of the year, although accidental releases and escapes can occur at any time.
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	N/A		Not relevant to this species.
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	moderately likely - 2	MEDIUM -1	Most of the African clawed frogs that are present in captivity in the UK are owned by commercial laboratories, which will be careful to prevent escapes, plus competent people who have an interest in amphibians and who realise the negative consequences of releasing these animals into the wild. The likelihood of this species being transferred in large numbers from captivity to the wild is therefore very substantially less than in previous years, and can only decline further with appropriate education and publicity. The organism is therefore unlikely to transfer from the pathway to a suitable habitat.

	Probability of Establishment	RESPONSE	UNCERTAINTY	COMMENT
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	slightly similar - 1	LOW - 0	The UK climate is mild to allow survival and limited breeding. However, *Xenopus laevis* originates from a Mediterranean climate (South Africa), so the present UK climate has not permitted this species to thrive, i.e. to increase in numbers or spread rapidly, so it has not become widely or firmly established.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	similar - 3	MEDIUM -1	Many water bodies in the UK are probably similar in other abiotic aspects to those in the natural range of *Xenopus laevis* .
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	many - 3	LOW - 0	There are numerous ponds and other water bodies that are potentially suitable for the long-term survival of this species in the UK. For example, this species is fairly tolerant of a range of conditions so potentially would be able to survive in a significant percentage of the estimated 400,000 or so ponds in the UK.
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	frequent - 3	LOW - 0	Widespread throughout the Risk Assessment area.
1.19	If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	N/A		Not relevant to this species.
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	very likely - 4	LOW - 0	*Xenopus laevis* has no direct competitors in the UK.
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	moderately likely - 2	MEDIUM -1	There will be fewer enemies present in the UK than in the native range and, due to the toxins possessed by *Xenopus* , some existing predators may not eat this species.
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	N/A	MEDIUM -1	Human management of UK water bodies and connecting habitats tends to be more intense than in many parts of the natural range of *Xenopus laevis* so would be more likely to hinder, rather than aid, establishment.
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	unlikely - 1	MEDIUM -1	Laboratory security has been increasingly improved over the years so escapes are now very unlikely. There appears to be no direct control over the illegal practice of releasing unwanted pets into the wild, although increased public education and publicity will have an impact in preventing this practice.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	very rare - 0	MEDIUM -1	No known records of feral *Xenopus* in such conditions.
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	unlikely - 1	MEDIUM -1	*Xenopus laevis* appears not to breed prolifically in the UK under current climatic conditions. Measey & Tinsley (1998) found that, although the south Wales population spawned fairly frequently, recruitment was only sporadic. Marked animals in this study had survived for 14 years, however (Measey 2001), so a large recruitment event would be possible should suitable weather conditions occur for even one season within this timeframe.
1.26	How likely is it that the organism's capacity to spread will aid establishment?	unlikely - 1	MEDIUM -1	Current distribution within the UK is very restricted and natural spread appears to have been very slow or non-existent under current climatic conditions.
1.27	How adaptable is the organism?	moderately adaptable - 2	MEDIUM -1	*Xenopus laevis* is very adaptable under the right (i.e. Mediterranean) conditions although it is less so in the UK.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	moderately likely - 2	MEDIUM -1	Unknown - presumably only a few individuals established the two known populations.
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	many - 3	LOW - 0	See the comment for Question 7.
1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	unlikely - 1	MEDIUM -1	As *Xenopus* occurs at so few sites in the UK, a deliberate, targeted eradication campaign would probably eliminate this species fairly rapidly, although follow-up surveys and control measures would be necessary. It is not known if any eradication campaigns have been successfully attempted elsewhere in the world.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	unlikely - 1	MEDIUM -1	Deliberate releases may still occur for some time to come, although see the comment for Question 1.14.

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	slow - 1	MEDIUM -1	*Xenopus* has been unable to spread far by natural means, despite being established at a small number of sites in the UK for several decades. Habitat connectivity is poor in the UK and, in any event, it is rarely simultaneously warm and rainy enough to encourage long distance overland movements by this species.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	intermediate - 2	MEDIUM -1	Humans could easily spread this species rapidly, although the risk of this happening appears to be decreasing.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	easily - 1	MEDIUM -1	So few sites are occupied in the UK that known populations could be readily controlled. *Xenopus* is inconspicuous, however, so surveys would be important in order to determine the success of any control measures.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.	The UK, primarily England and Wales	MEDIUM -1	N.B. This area is not at serious risk from *Xenopus laevis* at present and would only be 'endangered' by this species if rapid climate change allowed animals to build up numbers and spread more rapidly in the wild. In such a scenario, the areas most at risk would be any lowland areas of England, Wales, Scotland or Northern Ireland. Naturally, it is impossible to predict any future climate patterns, but it is likely that southern England and south Wales would be the warmest lowland areas and therefore most at risk.

	Impacts	RESPONSE	UNCERTAINTY	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	minimal - 0	LOW - 0	The limited distribution and very small numbers of *Xenopus laevis* present in the UK mean that economic losses, if any (see Questions 2.6 - 2.9), caused by this species are likely to be minimal.
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	minimal - 0	LOW - 0	There are virtually no means by which *Xenopus laevis* could cause direct negative economic effects. The two main risks would be due to: 1. predation on commercially valuable fish stocks, especially fish fry, in fishing lakes or freshwater fish farms. However, adult *Xenopus* in the UK largely consume invertebrates and would therefore have little impact on fish populations; 2. damage to commercial watercress beds due to increased turbidity caused by large numbers of adult frogs. These risks, however, are so minimal as to be unmeasurable.
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minimal - 0	LOW - 0	Under current climatic conditions, the small numbers of *Xenopus laevis* present in the UK would be unable to cause any noticeable losses in producer profits, e.g. to the fishing or watercress industries. Even if future climate change were to enable this species to rapidly spread in the UK, and all control methods subsequently failed, it is extremely unlikely that any losses to producer profits would be significant.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	Under current climatic conditions, the small numbers of *Xenopus laevis* present in the UK would be unable to cause any noticeable reductions in consumer demand, e.g. to the fishing or watercress industries. Even if future climate change were to enable this species to rapidly spread in the UK, and all control methods subsequently failed, it is extremely unlikely that any reductions in consumer demand would be significant.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	very unlikely - 0	LOW - 0	The number of exports that could ever conceivably be affected by *Xenopus laevis* are tiny, with fish farming and watercress production being the two main possible candidates. However, fish farms are unlikely to be troubled by this species since adults largely consume invertebrates. Commercial watercress production is also unlikely to be affected as individuals of this species would be very easy to remove in such environments.
2.10	How important would other economic costs resulting from introduction be? (specify)	minimal - 0	LOW - 0	Minor costs would be associated with a survey and eradication programme if this was ever deemed necessary.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	moderate - 2	MEDIUM -1	Under normal conditions, *Xenopus laevis* is unlikely to cause environmental harm within its natural geographic range in southern Africa. Where it has been introduced elsewhere in the world, especially to countries with a warmer, Mediterranean climate, this species can increase in numbers, spread rapidly and become invasive (although this has not happened to date in the UK). While concern has been expressed about various forms of environmental harm caused by these non-native populations of *Xenopus* (see Question 7), the most serious potential problem is the possible transmission of chytrid fungus from this species to native amphibians. This possibility is still under investigation by numerous researchers and is in fact still disputed by many scientists, who speculate that chytrid fungus was already endemic to many areas and that its spread was facilitated by the immune systems of native amphibians becoming compromised by other influences, such as chemical pollution. In reality, therefore, it is currently impossible to state with confidence whether any environmental harm caused by *Xenopus* is significant or is actually only minor.
2.12	How important is environmental harm likely to be in the Risk Assessment area?	moderate - 2	HIGH -2	Unknown at present. In the UK, this species has not increased in numbers or spread to new areas as it has in many warmer countries. Consequently, the environmental harm caused by *Xenopus* in the UK may well be minimal. However, the potential risk from chytrid infection should not be underestimated and so the risk here is therefore considered moderate. This potential problem has already been identified, however, and chytrid assessments are underway in the UK (Zoological Society of London 2008).
2.13	How important is social and other harm caused by the organism within its existing geographic range?	minimal - 0	LOW - 0	Not relevant to this species.
2.14	How important is the social harm likely to be in the Risk Assessment area?	minimal - 0	LOW - 0	Not relevant to this species.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	LOW - 0	Impossible - there are no similar native species in the UK.
2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no affect on populations of the organism if introduced?	moderately likely - 2	MEDIUM -1	Unknown.
2.17	How easily can the organism be controlled?	easily - 1	MEDIUM -1	So few sites are occupied in the UK that known populations could be readily controlled, e.g. by electro-fishing or, if deemed appropriate, poison. *Xenopus* is inconspicuous, however, so surveys would be important in order to determine the success of any control measures.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	very unlikely - 0	MEDIUM -1	Unlikely to conflict with the control of other organisms.

2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	likely - 3	HIGH -2	The most serious potential consequence of the introduction and spread of *Xenopus laevis* is that it is probably the original carrier (Weldon *et al.* 2004) of the chytrid fungus, *Batrachochytrium dendrobatidis* , which has been a contributory factor in amphibian declines in various parts of the world (although in the UK the Lincolnshire *Xenopus* colony has proved negative for this). However, the potential for environmental harm due to chytrid infection (spread by *Xenopus* or otherwise) of native UK amphibians has been taken seriously and a nationwide study is therefore already underway (Zoological Society of London 2008). In addition, it has recently been suggested that *Xenopus* may carry *Ranavirus* , another pathogen that can negatively impact amphibian populations (Robert *et al.* 2007). Like all animals, *Xenopus* species harbour a range of further diseases, such as *Chlamydia* (Reed *et al.* 2000), although none are thought to pose a serious risk.
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur	The UK, primarily England and Wales	LOW - 0	This is not relevant at present as any economic, environmental and social impacts are likely to be extremely minimal under current conditions. The potential risk of chytrid infection, although potentially serious, is small due to the tiny number of localities where this species is currently established.

Summarise Entry	moderately likely - 2	MEDIUM -1	Significant numbers of *Xenopus laevis* are still present in captivity, both in laboratories and as pets. A continued risk, although it is now a small and almost certainly still declining one, therefore exists of escapes or of people deliberately releasing unwanted animals into the wild in the UK.
Summarise Establishment	unlikely - 1	MEDIUM -1	Since *Xenopus laevis* currently does not appear to be able to breed prolifically or spread rapidly in the wild under current climatic conditions in the UK, and both the risk of further releases and the size of current populations seem to be declining, this species appears very unlikely to become permanently established here. However, potential future climate change does not rule out the spread of existing populations and the further establishment of this species. In the unlikely event that the UK develops a Mediterranean climate before all remaining *Xenopus laevis* populations have either died out or been removed, this establishment would be most likely to occur in southern England and parts of lowland south Wales.
Summarise Spread	slow - 1	MEDIUM -1	Historical evidence indicates that *Xenopus laevis* is unable to breed prolifically or spread rapidly in the UK. Aquatic dispersal corridors are limited and, furthermore, overland dispersal would normally occur in hot, wet conditions - but it is rarely warm and rainy enough at the same time in the UK to encourage such long distance terrestrial movements. The spread of *Xenopus* in the UK is therefore likely to remain slow for the foreseeable future.
Summarise Impacts	minor - 1	HIGH -2	The single most important potential impact of *Xenopus laevis* is the risk of spreading chytrid fungus to native UK amphibians. However, it is not currently known if this is occurring or how serious a risk this would pose. Other potential impacts, such as predation on or competition with native species, or economic damage, would be minor.
Conclusion of the risk assessment	LOW - 0	MEDIUM -1	*Xenopus laevis* is having very minimal impacts in the UK under current circumstances, with very few populations present in the wild (these may also be declining), the reduced ability of this species to reproduce here, the very limited potential for further spread without human assistance and an increasing recognition by the public that deliberate releases are undesirable. Furthermore, this species is very unlikely to be able to spread and become a major problem in such a modern industrialised country, even if climate change facilitated this. Even then, it would be relatively easy to control with only moderate resources. The main potential risk posed by this species is the spread of chytrid fungus to native amphibians, and this issue is already being addressed.
Conclusions on Uncertainty		MEDIUM -1	This risk assessment is reasonably reliable for the current situation and present climatic conditions in the UK. A number of uncertainties remain, however, due to the inconspicuous nature of *Xenopus laevis* and, in particular, the unknown impact of the possible spread of disease to other amphibians. It is possible, moreover, that future climate change may create unforeseen scenarios that would favour the more rapid establishment of this species and cause more severe impacts, although this is considered unlikely.

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