Annex 7. Risk Assessment for *Oxyura jamaicensis* (Ruddy Duck)

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:

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

Common misconceptions about risk assessments

The risk assessments:

26. 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 also only consider only the negative impacts of the species, they do not consider any positive effects. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
27. Are advisory and therefore part of the suite of information on which policy decisions are based.
28. 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 placed on the NNSS website, risk assessments are open for stakeholders to provide comment on the scientific evidence which underpins them for three months. 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

NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME
Name of organism: Ruddy Duck *Oxyura jamaicensis* Author: Iain Henderson Risk Assessment Area: All of the EU, including those areas with limited invasive populations presently occur Draft: Draft 2 (30/06/2014) Signed off by NNRAP: *to be completed* Approved by Programme Board: *to be completed* Placed on NNSS website: *to be completed*

SECTION A – Organism Information and Screening

	RESPONSE [chose one entry, delete all others]	**COMMENT**
Stage 1. Organism Information		
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	RUDDY DUCK *Oxyura jamaicensis*	Single taxonomic entity but known to hybridise with White-headed Duck *Oxyura leucocephala*, an endangered species native to the Mediterranean and central Asia.
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)	NOT APPLICABLE	
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	NO	
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	NOT APPLICABLE	

	RESPONSE [chose one entry, delete all others]	COMMENT
5. Where is the organism native?	North America, Central America, and the Andean regions of South America.	
6. What is the global distribution of the organism (excluding the European Union)?	Outside its native range (see 5), significant populations and breeding attempts only occur in the EU (UK, France, the Netherlands and Belgium). However birds appear as vagrants in a number of other countries, including Spain. Some small populations elsewhere (e.g. Iceland and Morocco) appear to have died out since the start of the UK eradication programme in 2005.	
7. What is the distribution of the organism in the European Union?	Approximately 40 wild birds remain in the UK. These occur in a small number of apparently separate populations, some of which may already be functionally extinct where female birds have been eradicated. The areas with these remaining populations include lowland Scotland, Northern Ireland, lowland England, and north Wales. The main viable concentrations however are found in central and southern England. In Belgium, small numbers of wild birds occur in Flanders, with the main concentration in the Antwerp area. In the Netherlands, a population of around 50 wild birds occurs in the west of the country. In France, a population of around 250 wild birds is found mainly in Brittany, with the main wintering site south of Nantes.	

	RESPONSE [chose one entry, delete all others]	COMMENT
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	YES	Ruddy Ducks are known to threaten the White-headed Duck *Oxyura leucocephala* with extinction through genetic introgression (*Green and Hughes, 1996; Hughes et al, 2006*). White-headed Ducks were formerly found throughout southern Europe, parts of North Africa and much of Central Asia. The European breeding population is now restricted to Spain, which is the only region in its range where the White-headed Duck has expanded its breeding range and population size in recent years. More than 186 Ruddy Ducks have been sighted in Spain since 1991 (*Torres, 2013)*, with the UK being the most likely source of most of these birds. Hybridisation between the two species is known to occur to the second and possibly third generation in the wild (*Green and Hughes, 1996*), thus increasing the risk to the White-headed Duck. A total of 69 hybrids have been culled in the wild in Spain as part of a national programme to prevent genetic introgression (*Torres, 2013*).
Stage 2. Screening Questions		
9. Has this risk assessment been requested by the GB Programme Board? (If uncertain check with the Non-native Species Secretariat)	YES	
10. What is the reason for performing the risk assessment?		

	RESPONSE [chose one entry, delete all others]	COMMENT
11. Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?		
12. Does the organism occur outside effective containment in GB?		
13. Is the organism widely distributed in GB?		
14. 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 GB, in the open, in protected conditions or both?		
15. 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)?		
16. Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in GB or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		
17. Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of GB or sufficiently similar for the organism to survive and thrive?		

	RESPONSE [chose one entry, delete all others]	COMMENT
18. Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in GB?		
19. 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?		
20. Can the organism spread rapidly by natural means or by human assistance?		
21. Could the organism as such, or acting as a vector, cause economic, environmental or social harm in GB?		

SECTION B – Detailed assessment

PROBABILITY OF ENTRY			
Important instructions: 29. Entry is the introduction of an organism into European Union. Not to be confused with spread, the movement of an organism within the EU. 30. For organisms which are already present in the EU, 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.			
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	FEW	HIGH	The main risk of entry is by means of escapes from collections of captive waterfowl – this was the original entry pathway which allowed the species to become established in the EU. Returns from a 1995 survey

pathways respond N/A and move to the Establishment section)			conducted in 39 European countries (*Callahan et al, 1997)* reported a total of 741 birds. However it was estimated that the true number of Ruddy Ducks at that time was in excess of 3,300 and thought to be increasing. Observed levels for duckling production suggested that the captive population had a high capacity for growth, particularly in Belgium, The Netherlands, UK, France and Germany, which held the largest captive populations. There are significant gaps in more recent data. At least 50 and probably more Ruddy Ducks are still held in private waterfowl collections in the UK (*Baz Hughes, pers. comm.).* Ruddy Ducks also occur in waterfowl collections in a number of European countries but in most cases there is no obligation to register birds and no official estimates are available. Data from *Cranswick and Hall (2010)* state that there are probably over 100 in France and between 10 and 100 in Luxemburg but no data are available for other EU states. Given the estimated numbers in the UK, France and Luxemburg, it is likely that the number of captive Ruddy Ducks across the EU will still number 1,000 or more. There is a risk that further escapes (or releases) could either bolster the remaining feral population or allow re-establishment once the current feral population has been eradicated. Ruddy Ducks can be kept and bred in captivity in many EU states including the UK, France, Belgium, Netherlands, Denmark, Germany and Italy. The trading of Ruddy Ducks is also legal in most EU states including the Netherlands, Belgium, Italy, the UK (under licence) and France (under licence). With only two exceptions (Hungary and Latvia), no member states monitor the status and distribution of captive Ruddy Ducks

			(*Cranswick and Hall, 2010)*. Most (but not all) member states have legislation prohibiting escapes or releases (*Cranswick and Hall, 2010*) but because so few member states monitor the status and distribution of captive birds, such legislation may be difficult to enforce. NB The original pathway of entry involved a series of escapes (and the deliberate release of three females) from a waterfowl collection in southern England. Breeding in the wild was first recorded in 1960 (*Hudson, 1976*) and this led to the establishment of a feral population which numbered c6,000 by the year 2000 (*Kershaw and Hughes, 2002*). This was subsequently greatly reduced by an eradication programme to a current population of approximately 40 individuals.
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. Escape or release of captive birds already held in EU.		
Pathway name:	ESCAPE OR RELEASE OF CAPTIVE BIRDS ALREADY HELD IN THE EU		

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 1.4, 1.9, 1.10, 1.11)	INTENTIONAL	MEDIUM	The species was intentionally imported from the US in the 1940s and is intentionally kept in a number of waterfowl collections. The original wild population in the UK derived from a number of birds which were deliberately not pinioned which effectively meant that they were intentionally released from captivity. A small number of birds were intentionally released directly into the wild when they were released at a local reservoir in order to augment the very small exiting breeding population (*Hudson, 1976*). This scenario could still occur in a number of member states given the numbers of captive birds still held.
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.	VERY LIKELY	MEDIUM	Although there is no official data on numbers of captive Ruddy Ducks in the EU, it seems likely that there could be over 1,000 held in waterfowl collections in the EU. There are probably more than 100 in France alone (*Cranswick and Hall, 2010*) with at least 50 in the UK (*Baz Hughes, pers. comm.*). A high proportion of keepers will be aware of the risks posed by the escape of this species but it remains possible that small numbers may escape into the wild and if these were of mixed sexes in the same area they would have the potential to establish a feral population. It is legal to keep Ruddy Ducks in captivity in many EU countries, and although some governments ban or restrict trade, it remains legal to trade Ruddy Ducks without a licence in at nine member states including Belgium, Italy and the Netherlands (*Cranswick and Hall, 2010*).

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.	NOT APPLICABLE	NOT APPLICABLE	
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	NOT APPLICABLE	NOT APPLICABLE	
1.7. How likely is the organism to enter EU undetected?	NOT APPLICABLE	NOT APPLICABLE	
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	NOT APPLICABLE	NOT APPLICABLE	
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	VERY LIKELY	HIGH	Ruddy Ducks are highly mobile and have shown that they can transfer quickly from captivity to suitable habitat in the wild (*Hudson, 1976* and *Hughes et al, 1999*).
1.10. Estimate the overall likelihood of entry into the EU based on this pathway?	VERY LIKELY	MEDIUM	Escapes from captivity were the source of the feral population which became established in the UK in the 1960s (*Hudson, 1976)* and in France, Belgium and the Netherlands in the 1990s. Although less likely to occur now due to better management of captive birds and better education regarding the risks of release, it is still very likely that small numbers of mixed sexes could escape into the wild and form a feral population.
1.11. Estimate the overall likelihood of entry into the EU based on all pathways (comment on the key issues that lead to this conclusion).	VERY LIKELY	HIGH	A feral population became established in the UK in the 1960s based on this pathway, and given the numbers of captive birds in collections in the EU, this could be repeated in a number of member states.

PROBABILITY OF ESTABLISHMENT			
Important instructions: 31. For organisms which are already well established in EU, only complete questions 1.15 and 1.21 then move onto the spread section. If uncertain, check with the Non-native Species Secretariat.			
QUESTION	**RESPONSE**	**CONFIDENCE**	**COMMENT**
1.12. How likely is it that the organism will be able to establish in the EU based on the similarity between climatic conditions in the EU and the organism's current distribution?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.13. How likely is it that the organism will be able to establish in the EU based on the similarity between other abiotic conditions in the EU and the organism's current distribution?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.14. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in the EU? Subnote: gardens are not considered protected conditions	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	

1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in the EU?	WIDESPREAD	HIGH	Ruddy Ducks can survive on a wide range of lowland waters, and breeding pairs have been noted in several member states (Sweden, Ireland, UK, France, Belgium, Germany, Spain and the Netherlands (*Cranswick and Hall, 2010*)). In their native range Ruddy Ducks breed in a number of biogeographic regions - the Andes from southern Chile up to Colombia, parts of Central America, Mexico, United States, Canada, and a number of Caribbean islands (*del Hoyo et al, 1992)*. Given this huge range in the Americas, it is likely that this will also be the case in Europe and also large parts of Asia.
1.16. 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 EU?	NOT APPLICABLE	NOT APPLICABLE	
1.17. How likely is it that establishment will occur despite competition from existing species in the EU?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.18. How likely is it that establishment will occur despite predators, parasites or pathogens already present in the EU?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.19. How likely is the organism to establish despite existing management practices in the EU?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.20. How likely are management practices in the EU to facilitate establishment?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	

1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in the EU?	UNLIKELY	HIGH	The UK eradication programme has seen numbers fall from around 6,000 in 2000 to a current estimate of 40 (*Henderson, 2014)*, and the biological properties of the Ruddy Duck have proved no hindrance to progress. It is expected that more control work in 2014/15 will see the population reduced still further, and it is expected that functional eradication can be achieved by the end of 2015.
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.23. How likely is the capacity to spread of the organism to facilitate its establishment?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.24. How likely is the adaptability of the organism to facilitate its establishment?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.26. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in GB? (If possible, specify the instances in the comments box.)	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
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.	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).	NOT APPLICABLE – ALREADY ESTABLISHED	NOT APPLICABLE	

PROBABILITY OF SPREAD			
Important notes: 32. 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 the EU by natural means? (Please list and comment on the mechanisms for natural spread.)	MAJOR	HIGH	Ruddy Ducks already have established feral populations in the UK, Belgium, France and the Netherlands. The UK population has fallen by 99% since 2000 as the result of a national eradication programme (*Henderson, 2014*), while the populations in France, Belgium and the Netherlands have fluctuated, but without the long-term declines achieved in the UK (*Cranswick and Hall, 2010* and *Robertson et el, 2014)*. Note that current numbers in the UK are estimated to be approximately 40 birds, with around 250 in France, 50 in the Netherlands and 12-15 in Belgium. Experience has shown that Ruddy Ducks are capable of spreading throughout the EU by natural means. Initial establishment occurred in SW England in the 1960s (*Hudson, 1976*). This was followed by a rapid spread through suitable habitat in the rest of England, Wales and Scotland between the mid-1970s and the late 1990s (*Kershaw and Hughes, 2002*). Breeding populations were established in The Netherlands and France by the mid-1990s, presumably by birds migrating from the UK (*Cranswick and Hall*, *2010*) and it is known that feral Ruddy Ducks in Europe are highly mobile and capable of covering long distances in order to establish a breeding population e.g. migration to and from

			Iceland (*Green and Hughes*, *1996* and *Muñoz-Fuentes et al, 2006*) and the close correlation between the rise and fall of the UK population and numbers being seen annually in Spain over the same period (*Henderson, 2009*, *Cranswick and Hall, 2010* and *Munoz-Fuentes et al,*
2.2. How important is the expected spread of this organism in the EU by human assistance? (Please list and comment on the mechanisms for human-assisted spread.)	MINIMAL	HIGH	Once established, spread is usually by natural means, although in theory it would be possible for birds to be deliberately relocated to new areas. In addition, it remains legal to trade Ruddy Ducks without a licence in nine member states (*Cranswick and Hall, 2010*), which could potentially assist the spread of the species.
2.3. Within the EU, how difficult would it be to contain the organism?	WITH SOME DIFFICULTY	HIGH	This would depend on the numbers involved and their locations. Research and experience gained from the eradication programme in the UK have shown that it is possible to significantly reduce numbers even when the population is large and widespread (*Henderson, 2009* and *Austin et al, 2014)*, but this entails significant investment in terms of time and money. In France numbers have been contained and reduced more slowly due to access difficulties surrounding the main wintering site at Lac de Grand-Lieu (*Alain Caizergues, pers. comm.*).

2.4. Based on the answers to questions on the potential for establishment and spread in the EU, define the area endangered by the organism.	MOST LOWLAND AREAS OF THE EU	HIGH	In their native range Ruddy Ducks breed in a number of biogeographic regions - the Andes from southern Chile up to Colombia, parts of Central America, Mexico, United States, Canada, and a number of Caribbean islands (*Del Hoyo et al, 1992)*. Given this huge range in the Americas (and the spread of Ruddy Ducks in NW Europe to date), it is likely that this will also be the case in the EU and that Ruddy Ducks are probably capable of colonising almost every Member State. The past presence of Ruddy Ducks in Morocco (*Hughes et al, 2006)* suggests that Ruddy Ducks are also capable of colonising Africa.
2.5. What proportion (%) of the area/habitat suitable for establishment (i.e. those parts of the EU where the species could establish), if any, has already been colonised by the organism?	0-10	HIGH	At present the remnant population in the UK occupies a small number of isolated pockets in Scotland, Northern Ireland, north Wales, and central and southern England. Elsewhere in Europe, Ruddy Ducks are regularly present at a number of sites in the western Netherlands, pockets of Flanders, and parts of western France. However the widespread distribution of Ruddy Ducks in the UK before the eradication programme began showed that they can inhabit a wide range of water bodies, so it is likely that the habitat currently colonised represents only a very small proportion of the suitable habitat in the EU.
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)?	0-10	LOW	If control were to cease immediately in all EU states, Ruddy Ducks might be expected to extend into between 8% and 10% of suitable habitat in five years, but there is a large degree of uncertainty around these figures.

2.7. What other timeframe (in years) would be appropriate to estimate any significant further spread of the organism in the EU? (Please comment on why this timeframe is chosen.)	20	MEDIUM	Data from the original colonisation in the UK show that numbers and spread began to increase rapidly about 15 years after first breeding in the wild (*Hughes et al, 1999*).
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?	10-33	MEDIUM	
2.9. Estimate the overall potential for future spread for this organism in the EU (using the comment box to indicate any key issues).	VERY LIKELY	HIGH	Based on evidence of spread during the period 1960 – 2000 and assuming that control ceases immediately.

PROBABILITY OF IMPACT
Important instructions: 33. 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. 34. 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). 35. Note questions 2.10-2.14 relate to economic impact and 2.15-2.21 to environmental impact. Each set of questions starts with the impact elsewhere in the world, then considers impacts in GB separating known impacts to date (i.e. past and current impacts) from potential future impacts. Key words are in bold for emphasis.

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range excluding the EU, including the cost of any current management?	MINIMAL	HIGH	Outside the EU, Ruddy Ducks currently cause minimal economic loss. The only non-EU state where control of the species has taken place is Morocco, which also has an indigenous White-headed Duck population (*Cranswick and Hall, 2010*). However this has not been necessary in recent years.
2.11. How great is the economic cost of the organism currently in the EU excluding management costs (include any past costs in your response)?	MINIMAL	HIGH	There is no economic cost to the EU (excluding management costs) arising from the presence of Ruddy Ducks.
2.12. How great is the economic cost of the organism likely to be in the future in the EU excluding management costs?	MINIMAL	HIGH	There is no economic cost to the EU (excluding management costs) arising from the presence of Ruddy Ducks.
2.13. How great are the economic costs associated with managing this organism currently in the EU (include any past costs in your response)?	MAJOR	VERY HIGH	Direct management costs to date in the UK have been a minimum of £6M (€7.2M). In Spain, management costs since 2000 are probably in the region of €0.6M (*Mario Saenz de Buruaga, pers. comm*.). Management costs for France are not available, but are estimated to lie somewhere between the costs of management in Spain and the costs of management in the UK. Thus total management costs for the EU (current and past costs) are likely to be in the region of €10-12M.
2.14. How great are the economic costs associated with managing this organism likely to be in the future in the EU?	MODERATE	HIGH	Five Member States have ongoing costs in the management of Ruddy Ducks – the UK, France, Netherlands (preparatory work only to date), Belgium and Spain. These are estimated to be in the region of £500,000 (€600,000) annually.

2.15. How important is environmental harm caused by the organism within its existing geographic range excluding the EU?	MASSIVE (likely global extinction in the wild of White-headed Duck if no action taken)	VERY HIGH	Besides the population of Ruddy Ducks in the EU, they have occurred in small numbers in the past in Morocco, where there is a population of the indigenous White-headed Duck which is at risk from hybridisation. Hybridisation is known to have occurred in Morocco in a number of years between 1999 and 2006 (*Hughes et al, 2006*) which means that there is a risk that this population of the White-headed Duck will become extinct through genetic introgression. Ruddy Ducks have also been recorded occasionally in other White-headed Duck range states outside the EU including Algeria, Israel (*Hughes et al, 2006*) and Turkey (*Cranswick and Hall, 2010*) and the White-headed Duck populations in these countries would be threatened if increasing numbers of Ruddy Ducks appeared.

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 the EU (include any past impact in your response)?	MINOR	VERY HIGH	In 1982 Ruddy Ducks were first recorded in Spain (*Cranswick and Hall, 2010*) and hybridisation with the White-headed Duck was first recorded in 1991 (*Hughes et al, 1999)*. It is likely that these Ruddy Ducks arriving in Spain originated from the GB population which was rapidly expanding in size and range at that time (*Cranswick and Hall, 2010)*. A minimum of 186 Ruddy Ducks have been recorded in at least 19 provinces in Spain since 1991 (*Torres, 2013* and *Carlos Gutierrez pers. comm.*). In captivity, Ruddy Duck x White-headed Duck hybrids are fertile to at least the third generation, and a total of 69 hybrids have been recorded in seven provinces in Spain since 1991 (*Torres, 2013* and *Carlos Gutierrez, per. comm*). However, to date this control programme in Spain has been effective in preventing any extensive introgression of Ruddy Duck genes into the Spanish White-headed Duck population (*Muñoz-Fuentes et al, 2007).*
2.17. How important is the impact of the organism on biodiversity likely to be in the future in the EU?	MASSIVE (likely extinction in the wild of White-headed Duck in EU if no action taken)	HIGH	If Ruddy Duck numbers are allowed to increase and their range is allowed to spread southwards to the main breeding grounds of the White-headed Duck in Spain, the likely outcome is the extinction of the White-headed Duck through genetic introgression. Hybridisation with the Ruddy Duck is now the most significant threat to the survival of the White-headed Duck (*Hughes et al, 2006*). If allowed to proceed unchecked, hybridisation between Ruddy Ducks and White-headed Ducks would be likely to lead to the extinction of the White-headed Duck through genetic introgression (*Green and Hughes, 1996*). This would occur not only in the Spanish population of White-headed Ducks. If Ruddy Ducks continued to spread east

			it would also lead to the extinction of the other White-headed Duck populations in eastern Europe and central Asia. Precedents exist elsewhere which demonstrate the potential threat e.g. the widespread hybridisation of the introduced Mallard *Anas platyrhynchos* and the native Grey Duck *Anas s. superciliosa* in New Zealand. By the early 1990s only an estimated 15-20% of the total *A. platyrhynchos/A. superciliosa superciliosa* population in New Zealand consisted of pure *A. superciliosa superciliosa* genotypes compared to an estimated 95% in 1960 (*Green, 1992, cited in Hughes et al., 1999*). *A. platyrhynchos* is now the dominant waterbird in the wetlands of the agricultural environment of New Zealand (*Gillespie 1985, cited in Hughes et al., 1999*). *A. platyrhynchos* also threatens a number of other species/subspecies with extinction through hybridisation, including *Anas undulata* in South Africa, *Anas melleri* in Madagascar and *Anas rubripes* and *A. platyrhynchos wyvilliana* in North America (*Browne et al., 1993, cited in Hughes, 1996; and Rhymer, 2006)*.
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions) caused by the organism currently in the EU (include any past impact in your response)?	MINIMAL	HIGH	Impacts in the UK during the period 1960 (establishment) to 2000 (peak population) and up to the present day appear to be negligible. It is assumed that the alteration of ecosystem function in other Member States would also be minimal.
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 the EU in the future?	MINIMAL	HIGH	Based on the above, future impact within the EU also seems likely to be negligible.

2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism currently in the EU?	MINIMAL	HIGH	Ruddy Ducks currently have no significant impact on conservation status in the EU because their numbers are being controlled, but significant declines could occur in the future (see 2.21).
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 the EU?	MODERATE	HIGH	If Ruddy Duck numbers in the EU were to increase and hybridisation were to become more extensive this would lead to the loss of the White-headed Duck and a decline in the value of a number of SPAs (such as El Hondo and Albuferas de Adrá) where the presence of the White-headed Duck is one of the reasons for the site being designated an SPA.
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?	MASSIVE	VERY HIGH	Ruddy Ducks are known to hybridise readily with White-headed Ducks both in the wild and in captivity. Hybrid offspring are fertile to at least the second generation in the wild (*Urdiales and Pereira, 1993*) and possibly to the third generation, thus increasing the risk to the genetic integrity of the White-headed Duck. Precedents from elsewhere (see Section 2.17) show that such genetic introgression is likely to lead to the extinction of the White-headed Duck, which would be replaced by a hybrid swarm.
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range?	MINIMAL	VERY HIGH	Ruddy Ducks are not known to cause any social harm, harm to health, or other harm beyond the threat posed to the White-headed Duck.
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)?	MINIMAL	HIGH	As far as is known the Ruddy Duck is not an important food species for any predator in the EU, nor is it a host, symbiont or vector for any other damaging organisms.

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)	NOT APPLICABLE	NOT APPLICABLE	No other impacts known or suspected.
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 the EU?	MASSIVE	HIGH	
2.27. Indicate any parts of the EU where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible).	NOT APPLICABLE	NOT APPLICABLE	

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Entry	VERY LIKELY	HIGH	The most likely pathway is escapes from captivity.
Summarise Establishment	VERY LIKELY	HIGH	If both sexes of Ruddy Ducks were to escape from captivity in the same location, it is highly likely that they could become established in the wild. This has already occurred with the founding of the original feral population in south-west England around 1960.

Summarise Spread	MODERATELY RAPIDLY	HIGH	Records from the period 1960 to 2000 showed that Ruddy Ducks are capable of spreading across large areas (*Cranswick and Hall, 2010*). In 1960 the population was restricted to a small area of south-western England and numbered around 20 birds. By 2000 the species had colonised most suitable habitat in the UK and had colonised parts of Iceland, Scandinavia, Ireland, the Netherland, and France, and numbered over 6,000. At least 186 Ruddy Ducks have been observed in Spain since 1984, with a peak of 27 in 1997 (*Torres, 2013* and *Carlos Gutierrez, pers. comm.*). It is likely that Ruddy Ducks would also have become established in Spain were it not for the control programme which resulted in the culling of almost all of these birds.
Summarise Impact	MASSIVE	HIGH	Threatens White-headed Duck with extinction if allowed to spread from its existing range in the UK, France, the Netherlands and Belgium, leading to Ruddy Ducks colonising large areas of western Europe followed by habitat in north Africa, eastern Europe and central Asia. If Ruddy Ducks were allowed to become widely established in other countries, their eradication would become impossible and it is likely that the White-headed Duck would become extinct through genetic introgression. Besides the risk of spread from existing populations, there is also a risk that the escape or release of captive birds will result in the establishment of another feral population even if the current one is eradicated.
Conclusion of the risk assessment	HIGH	HIGH	

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	NONE – Ruddy Ducks are adapted to a wide range of climates within their native range and in Europe are known to have bred as far north as Iceland and as far south as France. In addition, hybridisation with White-headed Ducks is known to have occurred in Spain and Morocco, so it is assumed that Ruddy Ducks are also capable	HIGH	

	of breeding further south.		
3.2. What is the likely timeframe for such changes?	NOT APPLICABLE	NOT APPLICABLE	
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	NOT APPLICABLE	NOT APPLICABLE	
ADDITIONAL QUESTIONS – RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	YES – SEE COMMENTS BOX	HIGH	McCRACKEN, K G, HARSHMAN, J, SORENSEN, M D, and JOHNSON, K P (2000). Are Ruddy Ducks and White-headed Ducks the same species? *British Birds, Volume 93, pp396-398* (Confirms Ruddy Ducks and White-headed Ducks are separate species, having developed separately for between 2M and 5M years). MUÑOZ-FUENTES, V, GREEN, A J, NEGRO J J (2013). Genetic studies facilitated management decisions on the invasion of the ruddy duck in Europe. Biological Invasions, Vol. 15, Issue 4, pp723-728. (Confirms Ruddy Ducks in Europe are the result of escapes from captivity).

REFERENCES:

AUSTIN, G, READ, W, CALBRADE, N, MELLAN, H, MUSGROVE, A, HEARN, R, STROUD, D, WOTTON, S, and HOLT, C (2014).

Waterbirds in the UK 2011/12 – The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT. British Trust for Ornithology, Thetford.

BROWNE, R A, GRIFFIN, C R, CHANG, P R, HUBLEY, M, and MARTIN, A E (1993). Genetic divergence among populations of the Hawaiian Duck, Laysan Duck and Mallard. *Ibis*, Vol. 110, pp 49-56.

CALLAHAN, DA, WORTH, N, HUGHES, B, BROWER, K (1997). European census of captive North American Ruddy Ducks (*Oxyura j. jamaicensis)*.

Wildfowl 48: 188-193

DEL HOYO, J, ELLIOTT, A, SARGATAL, J (1992). Handbook of the Birds of the World, Volume 1 Ostrich to Ducks. Lynx Editions, Barcelona.

CRANSWICK, P and HALL, C (2010). Eradication of the Ruddy Duck *Oxyura jamaicensis* in the Western Palaearctic: a review of progress and a revised Action Plan 2010–2015. WWT report to the Bern Convention.

GILLESPIE, G D (1985). Hybridisation, introgression and morphometric differences between Mallard *Anas platyrychnos* and Grey Duck *Anas superciliosa* in Otago, New Zealand. *Auk*, Vol. 102, pp 459-469.

GREEN, A J (1992). Wildfowl at Risk, 1992. *Wildfowl,* Vol. 43, pp 160-184.

GREEN, A J and HUGHES, B (1996). Action Plan for the White-headed Duck *Oxyura leucocephala*. In Heredia, B, Rose, L, and Painter, M (eds), *Globally Threatened Birds in Europe*, pp119-146. Council of Europe Publishing.

HENDERSON, I (2009). Progress of the UK Ruddy Duck eradication programme. British Birds Vol. 102, pp680-690

HENDERSON, I (2014). The UK Ruddy Duck Eradication Programme Project Bulletin. April 2014.

HUDSON, R (1976). Ruddy Ducks in Britain. British Birds Volume 69, pp132-143

HUGHES, B, CRIADO, J, DELANY, S, GALLO-ORSI, U, GREEN A J, GRUSSU, M, PERENNOU, C, TORRES, J A (1999). The status of the North American Ruddy Duck *Oxyura jamaicensis* in the Western Palearctic: towards an action plan for eradication, 1999-2002. Council of Europe Publication T-PVS/Birds (99) 9. Council of Europe Publishing, Strasbourg.

HUGHES, B, ROBINSON, J A, GREEN, A J, LI, Z W D, and MUNDKUR, T (2006). International Single Species Action Plan for the Conservation of the White-headed Duck Oxyura leucocephala. CMS Technical Series No. 13 & AEWA Technical Series No.8. Bonn, Germany.

KERSHAW, M and HUGHES, B (2002). The winter status and distribution of Ruddy Ducks *Oxyura jamaicensis* in the UK 1966/67 to 1999/2000. Wetland Advisory Service report to the Central Science Laboratory.

MUÑOZ-FUENTES, V, GREEN, A J, SORENSEN, M D, NEGRO, J J, and VILÀ, C (2006). The ruddy duck *Oxyura jamaicensis* in Europe: natural colonization or human introduction? Molecular Ecology, 15(6) 1441-1453.

MUÑOZ-FUENTES, V, GREEN, A J, SORENSEN, M D, NEGRO, J J, and VILÀ, C (2007). Hybridization between white-headed ducks and introduced ruddy ducks in Spain. Molecular Ecology, 16(3) 629-638.

MUÑOZ-FUENTES, V, GREEN, AJ, NEGRO, JJ (2013). Genetic studies facilitated management decisions on the invasion of the ruddy duck in Europe.

Biol. Invasions 15, 723-728

RHYMER, J (2006). Extinction by hybridisation and introgression in anatine ducks. Acta Zool. Sinica 52: 583-588

ROBERTSON, PA, ADRIAENS, T, CAIZERGUES, A, CRANSWICK, PA, DEVOS, K, GUTIÉRREZ EXPÓSITO, C. HENDERSON, I, HUGHES, B, SMITH, GC, MILL, AC (2014). Towards the European eradication of the North American ruddy duck. Biol Invasions DOI 10.1007/s10530-014-0704-3

TORRES ESQUIVIAS, J A (2013). Informe anual relativo a la población española de la malvasía cabeciblanca *Oxyura leucocephala.* Año 2012.

URDIALES, C and PEREIRA, P (1993). Identification key of *O. jamaicensis*, *O. leucocephala* and their hybrids. ICONA, Madrid