

## Risk Assessment of *Capreolus capreolus*

<b>Name of Organism:</b>	<i>Capreolus capreolus</i> Linnaeus, 1758 – roe deer
<b>Objective:</b>	Assess the risks associated with this species in Ireland
<b>Version:</b>	Final 22/09/2014
<b>Author(s)</b>	Erin O'Rourke, Liam Lysaght
<b>Expert reviewer</b>	Jochen Langbein

### Stage 1 - Organism Information

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### ***About the risk assessment***

This risk assessment is based on the **Non-native species Application based Risk Analysis (NAPRA)** tool (version 2.66). NAPRA is a computer based tool for undertaking risk assessment of any non-native species. It was developed by the European and Mediterranean Plant Protection Organisation (EPPO) and adapted for Ireland and Northern Ireland by Invasive Species Ireland. It is based on the Computer Aided Pest Risk Analysis (CAPRA) software package which is a similar tool used by EPPO for risk assessment.

**Notes:** Confidence is rated as low, medium, high or very high.  
Likelihood is rated as very unlikely, unlikely, moderately likely, likely or very likely.  
The percentage categories are 0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%.  
N/A = not applicable.

This is a joint project by Inland Fisheries Ireland and the National Biodiversity Data Centre to inform risk assessments of non-native species for the European Communities (Birds and Natural Habitats) Regulations 2011. It is supported by the National Parks and Wildlife Service.

## DOCUMENT CONTROL SHEET

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<b>Author (s):</b>	Dr Erin O'Rourke and Dr Liam Lysaght				
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## Version Control Table

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**Stage 1 - Organism Information**

The aim of this section is to gather basic information about the organism.


N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the risk assessment?	-	A risk assessment is required as this species is listed as a "Non-native species subject to restrictions under Regulations 49 and 50" in the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011, SI 477/2011.
2	Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES	<p><i>Capreolus capreolus</i> Linnaeus, 1758 – roe deer</p> <p>Taxonomy: Kingdom: Animalia Phylum: Chordata Subphylum: Vertebrata Class: Mammalia Order: Artiodactyla Suborder: Ruminanta Family: Cervidae Subfamily: Capreolinae Genus: <i>Capreolus</i> Species: <i>capreolus</i></p> <p>Synonyms: n/a</p> <p>Common name (English): roe deer, European roe deer, western roe deer</p> <p>The taxonomy and systematics of the European doe deer have been based on morphological and genetic data. Three subspecies have been confirmed by molecular data: <i>C. c. italicus</i> Festa, 1925; <i>C. c. garganta</i> Muenier, 1983; and <i>C. c. capreolus</i> Linnaeus, 1758 (Lorenzini <i>et al.</i> 2002; Randi <i>et al.</i>, 2004; Lorenzini and Lovari 2006). A provisional name of <i>C. c. caucasicus</i> has been given to a large-sized subspecies north of Caucasus Mountains (Sempéré <i>et al.</i>, 1996, Lister <i>et al.</i>, 1998). In the western Asia animals have been assigned to <i>C. c. coxi</i> (Harrison and Bates 1991).</p>
3	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	

**Stage 1 - Organism Information***The aim of this section is to gather basic information about the organism.*

N	QUESTION	RESPONSE	COMMENT
4	Describe the organism.	-	<p>The roe deer is a small to moderate-sized deer, with a body length of 95–138 cm, a shoulder height of 60–70 cm, and a weight of 15–35 kg (Hewison and Staines, 2008). Roe deer has a reddish-brown summer coat with a grey face, darkening to brown or even approaching black in winter, with lighter undersides and a white rump patch (LHN, 2014). Apparently tailless except that anal tuft of hair in females is prominent in winter coat (Hewison and Staines, 2008). Only the males generally have antlers, although very occasional antlered females are known. The first and second set of antlers of bucks are rather short (5–12 cm), erect and unbranched, while older males in good conditions develop antlers up to 20 to 25 cm long with two or three, rarely even four, points (Hewison and Staines, 2008; LHN, 2014). When the male's antlers begin to regrow (almost immediately after they are shed), they are covered in a thin layer of velvet-like fur which disappears later on after the hair's blood supply is lost (Hewison and Staines, 2008; LHN, 2014)</p> <p>They have a distinctive black nose with white chin and also, commonly, black chinstrap (Hewison and Staines, 2008). They are also distinguished from muntjac by upright stance (muntjac often hunched) and pointed ears (Hewison and Staines, 2008). In reddish summer coat can be mistaken for red deer, but much smaller, shorter muzzle (Hewison and Staines, 2008). Stance and movement of roe deer is like Chinese water deer, but roe larger and has conspicuous white caudal (rump) patch (Cooke and Farrell, 2008). When disturbed, characteristic bounding gait with white-cream rump patch (target) flared, while often giving dog-like barks (Hewison and Staines, 2008).</p>
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	YES	In Ireland, a preliminary risk assessment was previously carried out. This was a prioritisation risk assessment as part of the Risk Analysis and Prioritisation for Invasive and Non-native Species in Ireland and Northern Ireland (ISI, 2012). It designated <i>Capreolus capreolus</i> as a “high risk” non-native species.
6	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	PARTIAL	Only a preliminary risk assessment was previously conducted in Ireland (refer to Question 5)
7	Where is the organism native?		The species is native to Albania; Andorra; Armenia (Armenia); Austria; Azerbaijan; Belarus; Belgium; Bosnia and Herzegovina; Britain; Bulgaria; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Gibraltar; Greece; Greenland; Hungary; Iran, Islamic Republic of; Iraq; Italy; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Moldova; Monaco; Montenegro; Netherlands; Norway; Poland; Portugal; Romania; Russian Federation; San Marino; Serbia (Serbia); Slovakia; Slovenia; Spain; Sweden; Switzerland; Syrian Arab Republic; Turkey; Ukraine (Lovari <i>et al.</i> , 2008).

**Stage 1 - Organism Information**

The aim of this section is to gather basic information about the organism.

N	QUESTION	RESPONSE	COMMENT
			 <p data-bbox="940 1117 1900 1169"><b>Figure 1.</b> Native and extinct range of roe deer (<i>Capreolus capreolus</i>; modified from Lovari <i>et al.</i>, 2008).</p>
8	What is the current global distribution of the organism (excluding Ireland)? (map optional)		The species has a large range in the Palearctic (Lovari <i>et al.</i> , 2008). It is found through most of Europe (with the exception of Cyprus, Corsica, Sardinia, Sicily, and most of the smaller islands), including western Russia (Stubbe 1999). Outside Europe, it occurs in Turkey, northern Syria, northern Iraq, northern Iran, and the Caucasus (Wilson and Reeder 2005). It is extinct in Israel

**Stage 1 - Organism Information***The aim of this section is to gather basic information about the organism.*

N	QUESTION	RESPONSE	COMMENT
			and Lebanon (Wilson and Reeder 2005). The countries to which the species is native are listed in Question 7.
9	What is the current distribution of the organism in Ireland? (map optional)		<p>Roe deer were introduced to Ireland during 1860's and 1870's and shot out during 1<sup>st</sup> half of the 20<sup>th</sup> century (Prior, 1995). For example, roe deer from Scotland were introduced to the Lissadell Estate in Co. Sligo around 1870 by Sir Henry Gore-Booth (Tegner, 1951). The Lissadell deer were noted for their occasional abnormal antlers and survived in that general area for about 50 years before they died out (Tegner, 1951).</p> <p>In May 2014, the National Biodiversity Data Centre recieved a sighting of roe deer via the Centre's online invasive species recording system. This sighting of roe, which was recorded at a conifer planation in Slieve Gullion, Co. Armagh has been verified – two people saw the deer, reportedly 1 male and 2 females and one buck was photographed. Since this time there have been five additional trail camera sightings of roe in this area (Darren Rice per comm., 30<sup>th</sup> July, 2014), which have yet to be verified as recordings.</p> <p>The Data Centre also received reports of roe in Co. Wicklow, these records are awaiting verification (Sept, 2014). A population is believed to have been delierately introduced to the Kippure Estate, Co. Wicklow circa 2011 (Enda Mullins per. comm., 29<sup>th</sup> May 2014 ). Deliberate introduction of the species has most likely resulted in translocation to new areas and/or escape or intentional release from captive populations. In January 2011 there was a sighting of an individual animal in the Kippure area. In May 2011 a herd of five (two bucks and three doe) were sighted by a hunter in Ballinatoe, Co. Wicklow. Mating calls were noted in the Ballynabrocky area in July 2011. The most recent sighting of roe comes from Ballynascullogue Lower, Co. Wicklow in December 2013 (Enda Mullins per. comm., 29<sup>th</sup> May 2014).</p>
10	Is the organism known to be invasive anywhere in the world?	NO	To the authors knowledge there is no published literature documenting roe deer as an invasive species (i.e. known to have intrinsic attributes that indicate a species is, or could be, threatening to other species, habitats or ecosystems). Roe deer may be considered as a pest of the agricultural, forestry and transport sectors. In Britain, where roe deer are common, the species may cause damage to agricultural crops (Packer <i>et al.</i> , 1998; Putman and Moore, 1998) although impacts are highly localised and not of regional or national economic significance (Packer <i>et al.</i> , 1998; Putman <i>et al.</i> , 2003). The species may damage forestry through browsing and fraying young trees, which may delay tree regeneration or establishment, particularly conifers (Gill, 1992a,b; Gill <i>et al.</i> , 2000; Ward <i>et al.</i> , 2004; Welch <i>et al.</i> , 1991). Selective browsing may alter forest species composition (Cederlund, 1998). Roe deer are the commonest deer involved in road traffic accidents in Europe (Bruinderink and Hazelbroek, 1996; Langbein, 2011).

**Stage 1 - Organism Information**

*The aim of this section is to gather basic information about the organism.*

N	QUESTION	RESPONSE	COMMENT
			Although roe deer are not documented or labelled as an invasive species and may presently be best described as a pest, it is noteworthy that 20 years ago in Britain muntjac were described as not invasive (Alastair Ward, per. comm., 1 <sup>st</sup> March 2014). Today muntjac are known to damage conservation features in woodland reserves. It, therefore, cannot be discounted that invasive impacts of roe deer have potential to manifest, especially in a country such as Britain where the species is well established and continues to spread (Hewison and Staines, 2008).

**Stage 2 - Detailed assessment: Section A - Entry**

*This section evaluates the probability of entry of an organism into Ireland. For organisms which are already present, only complete the entry section for currently active pathways of entry and potential future pathways. The entry section need not be completed for pathways which have allowed an organism to enter in the past but are no longer active.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.01	How many active/future pathways are relevant to the potential entry of this organism (n/a, very few, few, moderate number, many or very many)?	FEW	HIGH	There are few future pathways relevant to the entry of <i>C. capreolus</i> .
1.02	List significant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways.	1. Deliberate introduction 2. Natural colonisation	HIGH	The main relevant future pathway to the potential entry of the species is one of deliberate introduction. Deliberate introductions would most likely to be from established populations in Britain. Deliberate introduction of the species may subsequently lead to translocation to new areas and/or escape or intentional release from captive populations.  It is very unlikely, but not entirely implausible that roe could swim or be swept across 15 – 20km across channel from Scotland. Roe are good swimmers, known to cross some estuaries in Scotland, and while only very low likelihood (not least in view of no recorded history of such entry) it is a pathway that cannot entirely be ruled out.

**Pathway 1 – Deliberate introduction**

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.03	Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (e.g. the organism is a contaminant of imported goods)?	INTENTIONAL	VERY HIGH	Entry of roe is highly likely to be intentional i.e. introduced by man. It is likely that introductions would be for sport/hunting, as ornamental animals for perceived 'landscape improvement' or holdings within private wildlife collections and/or zoos.
1.04	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?	UNLIKELY	HIGH	There are no reliable data that exists to allow a reasonable assessment to be made of the number of animals that may, or may not, be brought into Ireland. The number of roe deer potentially entering Ireland via a pathway of deliberate introduction would be expected to be low, infrequent and dependent on the demand for the species by hunting enthusiasts and/or estate managers.



<b>Pathway 1 – Deliberate introduction</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	LIKELY	HIGH	It is likely that this species could enter Ireland without the knowledge of the competent authorities. This is substantiated by the recordings of the roe in Ireland; indicating that successful introductions have taken place without the knowledge of the competent authorities.
1.06	How likely is the organism to survive during passage along the pathway?	LIKELY	HIGH	Likely for the species nutritional and housing requirements to be catered for by the importer. Deer are easily stressed (Harris and Yalden, 2008) and may suffer mortality during transport, but previous successful introductions from continent to Britain not uncommon and introduction(s) from a currently unknown area into Ireland have been successful.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	MODERATELY LIKELY	MEDIUM	Establishment success would be initially dependent on the introduction of either a pregnant female (carrying at least one male kid) or one sexually mature roe deer of each sex. The rutting period, in England, is from mid July to end of August (Hewison and Staines, 2008). It is moderately likely for the species to arrive during these months of the year most appropriate for establishment.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	Roe deer are a mobile species that can move from their area of initial introduction wherever suitable habitat can be reached, although their overall range may be limited by mountain ranges and other natural barriers. Roe deer occupy a wide variety of habitats, including deciduous, mixed or coniferous forests, moorland, pastures, arable land, and suburban areas with large gardens (Hewison and Staines, 2008). The species prefers landscapes with a mosaic of woodland and farmland (Stubbe 1999). Roe deer are well adapted to modern agricultural landscapes (Andersen <i>et al.</i> , 1998, Danilkin 1996; Sempéré <i>et al.</i> , 1996). The species is likely to be introduced to and/or encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000).
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	LIKELY	HIGH	Entry is likely via deliberate introduction. In recent times, roe has been verified as present in Co. Armagh and has been reported in Co. Wicklow (refer to Question 9). The stock is most likely from Britain and most likely to be as a result of interest in exploitation as a game species. Some shooting/stalking estates like to be able to advertise ability to shoot several different deer species, so that temptation for such illegal release of non-natives game species exists.

<b>Pathway 1 – Deliberate introduction</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.10	Do other pathways need to be considered?	YES	MEDIUM	

<b>Pathway 2 – Natural colonisation</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.03	Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (e.g. the organism is a contaminant of imported goods)?	ACCIDENTAL	VERY HIGH	The natural pathway of roe deer arriving by swimming / swept across sea from Britain while attempting to cross an estuary is unlikely but not entirely unfeasible; and could also be regarded as accidental.
1.04	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?	VERY UNLIKELY	HIGH	No such previous entry and subsequent establishment by roe via this pathway is known, but crossing of sea estuaries wider than 5km by roe deer have been reported elsewhere (Jochen Langbein, per. comm., 24 <sup>th</sup> March 2014). As such, if it occurred at all, numbers involved would be likely to be very small.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	UNLIKELY	HIGH	As this pathway is one with low likelihood and then only limited to narrowest parts of seas between Britain and Ireland, deer arriving this way are moderately likely to be spotted during transition or soon after.
1.06	How likely is the organism to survive during passage along the pathway?	UNLIKELY	MEDIUM	Given 15km or greater sea barrier, high likelihood deer swimming/swept on tide would succumb to hypothermia.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	MODERATELY LIKELY	LOW	If roe deer arrived at all via this pathway, spring/summer dispersal season would be most likely.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	If surviving for some time after arrival, given adaptability of roe deer to many habitat and landscape types transfer to suitable habitat is likely.
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	UNLIKELY	HIGH	Entry is unlikely via natural colonisation.
1.10	Do other pathways need to be considered?	NO	HIGH	

<b>Overall likelihood</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.11	Estimate the overall likelihood of entry into Ireland based on all pathways (comment on the key issues that lead to this conclusion).	LIKELY	HIGH	The main pathway is deliberate introduction, as no previous entry of roe via natural colonisation is known. Entry is likely via deliberate introduction. In recent times, roe has been verified as present in Co. Armagh and has been reported in Co. Wicklow (refer to Question 9). The stock is most likely from Britain and most likely to be as a result of interest in exploitation as a game species. Some shooting/stalking estates like to be able to advertise ability to shoot several different deer species, so that temptation for such illegal release of non-natives game species exists.

**Stage 2 - Detailed assessment: Section B – Establishment**

*This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	NO	HIGH	Evidence which is currently emerging (refer to Question 9) suggests that roe deer have a localised and scattered distribution and may not be best described as well established. Research is needed to confirm whether the current records/sightings of roe in Ireland represent an established population i.e. breeding population.
2.02	How likely is it that the organism will be able to establish in Ireland based on the similarity between local <u>climatic conditions</u> and the organism's current global distribution?	VERY LIKELY	HIGH	The majority of <i>C. capreolus</i> geographical range falls within the temperate climatic zone, although the species is cold tolerant, with populations extending into the polar zone i.e. Norway, Sweden and Finland. The species is tolerant of climatic extremes (Mediterranean to Arctic Circle) but snow depth defines northern European limit (Danilkin, 1996). The species is also widespread across the United Kingdom (Hewison and Staines, 2008), Ireland's nearest and climatically similar neighbour. The species range, therefore, includes climatic conditions comparable with Ireland; a temperate oceanic climate which is mild, moist and changeable, with abundant rainfall and lack of temperature extremes (Keane and Collins, 2004).
2.03	How likely is it that the organism will be able to establish in Ireland based on the similarity between other local <u>abiotic conditions</u> and the organism's current global distribution?	VERY LIKELY	HIGH	It is likely that the species could become well establish in Ireland due to the similarities of their abiotic conditions with Britain, as well as the widespread and almost continuous range across continental Europe.
2.04	How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland?	VERY LIKELY	HIGH	If or when deliberately introduced to Ireland, introductions are likely to take place in habitats suitable for survival, development and multiplication of the species. Roe deer occupy a wide variety of habitats, including deciduous, mixed or coniferous forests, moorland, pastures, arable land, and suburban areas with large gardens (Hewison and Staines, 2008). The species prefers landscapes with a mosaic of woodland and farmland (Stubbe 1999). Roe deer are well adapted to modern agricultural landscapes (Andersen <i>et al.</i> , 1998, Danilkin 1996; Sempéré <i>et al.</i> , 1996). The species is likely to be introduced and/or encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000).

**Stage 2 - Detailed assessment: Section B – Establishment**

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N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.05	How likely is it that establishment will occur despite competition from existing species in Ireland?	VERY LIKELY	HIGH	<p>Competition has not significantly prevented roe deer from becoming established in England (Hewison and Staines, 2008). Roe deer introduced into Ireland may compete with red, fallow and sika deer, the latter species considered competitively superior (Hearney and Jennings, 1983; Hewison and Staines, 2008; Latham <i>et al.</i>, 1996, 1997), within those limited areas of Ireland where those large deer species are present at high density. In most parts of Ireland however, there would be little barrier to establishment of roe, other than deliberate culling to prevent such spread. Diet and habitat overlap probably greatest with muntjac (Chapman <i>et al.</i>, 1993) and roe densities can be lowered 20% where are muntjac present (Wray, 1993). Recordings of muntjac exist for Ireland, and it is most likely that muntjac would present as roe deer's most significant competitor. If Chinese water deer were to be established along with roe deer, these two species are also likely to compete (Cooke, 2009), in this instance roe deer are, however, more likely to be competitively superior (National Trust, 2008). For example, at Wicken Fen in Cambridgeshire and at Redgrave and Lopham Fen in Suffolk, England, where muntjac and roe are established, water deer are still rare or occasional (National Trust, 2008). Note, Chinese water deer are not known to be present in Ireland.</p>
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?	LIKELY	HIGH	<p>European data indicates foxes (<i>Vulpes vulpes</i>) as a predator, and can take up to 40% or more of kids (&lt;2 months old), mostly male kids if lying in open habitat (Hewison and Staines, 2008). However, such predation must be seen in context of roe regularly producing twins or even triplets. Golden eagle predation on kids has also been recorded in Great Britain (Ratcliffe and Rowe, 1979). Feral dogs may be predators (Lorenzini <i>et al.</i>, 2002). Humans are the main predator of the species (Hewison and Staines, 2008), both through hunting, as well as road traffic casualties.</p> <p>A few ectoparasites are known; keds (<i>Ixodes ricinus</i>), sucking louse (<i>Solenopotes burmeisteri</i>), biting louse (<i>Damalinia meyeri</i>) and ticks (<i>Ixodes ricinus</i>). <i>Cephenomyia stimulator</i> is a nasal blowfly specific to roe deer in the Britain (Hewison and Staines, 2008). Lungworms <i>Dictyocaulus</i> spp. cause significant mortality in roe in some areas (Munro, 1986). Many gastrointestinal parasites present; liver fluke <i>Fasciola hepatica</i> very common in some areas and effects can be serious</p>

**Stage 2 - Detailed assessment: Section B – Establishment**

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N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				<p>(Dunn, 1986) and perhaps limit populations (Fletcher, 2002). <i>Babesia capreoli</i> a blood haemoprotozoon (redwater) transmitted by ticks, is common in Scotland although clinical signs are rare (Fletcher, 2002) and deaths are unknown (Wood and Munro, 1986). The protostrongylid <i>Elaphostrongylus cervi</i> (tissue worm) regularly found and heavy infestation may cause a loss of lung function (Fletcher, 2002). With reference to the widespread establishment of the species in Britain, potential establishment of the species in Ireland is not expected to be significantly prevented by predators, parasites or pathogens.</p>
2.07	How likely is it that establishment will occur despite existing management practices?	LIKELY	MEDIUM	<p>As of yet there are no control/eradication measures in place for roe in Ireland. If control measures were to be employed they would be largely the same as used for control of impacts and spread fallow, sika and red deer Ireland. How likely establishment will be despite the implementation of management practices, will be largely dependent on policies and incentives to prevent their spread. Provided early action is taken where roe deer are noted to have been introduced, it is likely that their establishment and spread could be slowed significantly or prevented using existing methods of deer control. If the species were to become established they may be discriminately or indiscriminately hunted and numbers controlled by sporting hunters. If species' establishment resulted in negative economic, environmental and/or social impacts governmental led management through routine and systematic culling of the species may be required. Across the species current or extinct range management operations specific to the species such as re-introductions, restocking, translocations and improved hunting regimes have facilitated establishment (Lovari <i>et al.</i>, 2008; LHN, 2014).</p>
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?	MODERATELY LIKELY	MEDIUM	<p>It is unknown at present whether sectoral (e.g agriculture, forestry, transport) management practices will facilitate the establishment of this species. Having almost gone extinct in parts of southern Europe because of habitat loss and over harvesting in the first half of the last century, its numbers started increasing again 20-40 years ago because of countryside abandonment, improved hunting regimes and reintroduction (LHN, 2014). In Britain roe deer were also still largely absent from large parts of England during the early parts of the last century, but population</p>

**Stage 2 - Detailed assessment: Section B – Establishment**

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N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				growth and recolonisation of most of England have been aided by extensive re-afforestation as well as introduction of close seasons and restriction on permitted weapons for deer control over the past 50 years.
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?	MODERATELY LIKELY	LOW	The species is under one metre in height, in summer has a tendency to be solitary, is most active around dawn and dusk and is a good swimmer (Cooke and Farrell, 2008). If the species were to establish in Ireland, these characteristics are likely to make it hard to eradicate. Bedding sites chosen for cover (and proximity to feeding grounds), seeking to lower chance of visual detection (Mysterud, 1996). From six months old, roe, especially males or solitary individuals, give short repeated barks (av. 14/min) in response to disturbance, particularly at dawn and dusk (Hewison and Staines, 2008). If disturbed often cut back behind source, or lie flat and hide until disturbance has passed (Hewison and Staines, 2008). The species will also swim (Hewison and Staines, 2008). The low confidence answer is highly dependent on what form an 'eradication campaign' would take. By comparison to attempts to eradicate muntjac, and historical eradication of introduced roe in Ireland as well as in parts of England, given the right incentives to local landholders should roe become established, their containment and eradication should be feasible provided early action is taken.
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?	MODERATELY LIKELY	MEDIUM	The rutting period, in England, is from mid July to end of August (Hewison and Staines, 2008). Females are monoestrous (one cycle a year); can breed for the first time at about 15 months of age; practically all (>98%) adult does ovulate and are fertilised; pregnancy c.300 days; birth peak is in May-mid June; twins are the most common litter size, with triplets increasingly common when environmental conditions are good; and roe offspring received the highest known postnatal maternal care among ungulates (Gaillard <i>et al.</i> , 1992; Hewison and Staines, 2008). These reproductive traits of roe deer facilitate establishment. On the other hand, roe kid survival over the first summer is low and highly variable between years (20-100% in England; Gall, 1994), depending on climatic conditions, habitats and food supply (Gaillard <i>et al.</i> , 1997).

**Stage 2 - Detailed assessment: Section B – Establishment**

*This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?	LIKELY	HIGH	Roe deer bucks are territorial and young deer will disperse to take up own ranges. Female dispersal is thought to be voluntary and male dispersal may be enforced by aggression from territorial males, particularly towards heavy yearlings with large antlers which may be potential competitors (Wahlström, 1994). Generally 20-75% of both male and female yearlings disperse a few km, although distances >20km recorded in Scottish farmland (Hewison and Staines, 2008) and may preferentially disperse along woodland corridors in agricultural landscapes (Coulon <i>et al.</i> , 2006). Territory size can vary according to habitat, population densities and season (Hewison and Staines, 2008), but population density and sex do not influence fine-scale natal dispersal in roe deer (Gaillard <i>et al.</i> , 2008), with median dispersal distances between 1 .5 to 3.5 km from natal range. Home range size of males and females at Chedington, Dorset, England, recorded as 5.2±2.5 and 4.55±2.5 ha, respectively (Johnson, 1982). As territories are <10 ha, rates of dispersal could not be considered as rapid.
2.12	How likely is it that the organism's adaptability will facilitate its establishment?	LIKELY	HIGH	The species current wide ranging geographic distribution (refer to Question 9) is indicative of the species ability to adapt. As detailed in Question 2.02, 2.03 and 2.04 the species is likely to adapt easily to Ireland particularly due to the similar climate and landscape the island shares with Britain, where the species is widespread. Lovari <i>et al.</i> (2008) notes that, in general, this species can quickly re-build its numbers and may tolerate a relatively high hunting pressure, if in a suitable habitat and under an appropriate hunting regime.
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?	LIKELY	MEDIUM	In historical time's roe deer was close to extinction throughout much of Great Britain and by c.1700 thought to survive only in remnant woodlands in parts of central and north west Highlands of Scotland (Whitehead, 1972). However, species population increased in woodlands during the 18 <sup>th</sup> century resulting in a range expansion that reached the Scottish Borders by 1840 (Hewison and Staines, 2008). This may be indicative of the species ability to (re)establish despite low genetic diversity. The Scottish population of roe deer are considered to represent the native British phenotype (Hewison, 1997), with two other morphological types of roe deer identified undoubtedly deriving from European introductions



**Stage 2 - Detailed assessment: Section B – Establishment**

*This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				<p>(Hewison and Staines, 2008). There are little data available to inform whether the species could establish with low genetic diversity.</p> <p>As a side note: the genetic differentiation between populations of roe deer across Europe are considered high (Hartl, 1998). Although the International Union for the Conservation of Nature lists the species as Least Concern, it does note that the main threat in Europe is the increased mixing of various genetic stocks as a result of translocations (Lorenzini <i>et al.</i>, 2002). This may be a particular threat to genetically distinct peripheral populations, such as those in northern Portugal, the southern Italian Apennines, and Greece (Lorenzini <i>et al.</i>, 2002). Molecular studies show that roe deer in central and southern Europe are mainly admixed, indicating that human manipulation has greatly affected the natural genetic structure of population (Lorenzini <i>et al.</i>, 2002) .</p>
2.14	Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in Ireland? If possible, specify the instances of invasion elsewhere in the justification box	LIKELY	HIGH	As the species is not considered invasive there is no history of invasion. In Ireland it is likely that the species could establish, as Ireland shares a similar climate and landscape to Britain where it is already established and widespread.
2.15	If the organism does not establish, then how likely is it that transient populations will continue to occur?	MODERATELY LIKELY	MEDIUM	Roe deer were introduced to Ireland during 1860's and 1870's and shot out during 1 <sup>st</sup> half of the 20 <sup>th</sup> century (Prior, 1995). For example, roe deer from Scotland were introduced to the Lissadell Estate in Co. Sligo around 1870 by Sir Henry Gore-Booth (Tegner, 1951). The Lissadell deer were noted for their occasional abnormal antlers and survived in that general area for about 50 years before they died out (Tegner, 1951). This historic introduction but failure of the species to naturalise may highlight the potential for short-lived individuals or populations to occur on the island. Whereas roe deer were shot out from that Sligo population early during the last century, more restrictive firearms legislation and on permitted methods of deer control, as well as smaller landholding sizes may lead to future eradications to be achieved less readily.

**Stage 2 - Detailed assessment: Section B – Establishment**

*This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.16	Estimate the overall likelihood of establishment. Mention any key issues in the comments box	LIKELY	HIGH	It is likely that the species could establish, as Ireland shares a similar climate and landscape to Britain where it is already established and widespread. Moreover, introductions are likely to take place in habitats suitable for survival, development and multiplication and roe deer can occupy a wide variety of habitats, including deciduous, mixed or coniferous forests, moorland, pastures, arable land, and suburban areas with large gardens (Hewison and Staines, 2008). Competition with other species or predation for natural enemies has not significantly prevented roe deer from becoming re-established throughout most of England (Hewison and Staines, 2008), which in the event of introduction to Ireland is also likely to be the case. No sectoral (e.g. agriculture, forestry, transport) management practices are known to exist which would aid species establishment. Similarly, there are no management practices in place to control the species, although similar approaches to control as used for red, fallow and sika already established would be appropriate also for management of roe. It is likely that the species high breeding rate, adaptability and capacity to spread will facilitate establishment.

**Stage 2 - Detailed assessment: Section C – Spread**

*This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.01	What area (given in % or 10km squares) in Ireland could the organism establish (0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%)?	68% -90%	HIGH	Roe deer occupy a wide variety of habitats, including deciduous, mixed or coniferous forests, moorland, pastures, arable land, and suburban areas with large gardens (Hewison and Staines, 2008). With reference to the CORINE land cover classification roe deer have the potential to establish in about 75% of the Irish landscape - green urban areas (0.04%), non-irrigated arable land (7.53%), pastures (50.23%), land principally occupied by agriculture with areas of natural vegetation (6.27%), broad leaved forest (0.41%), coniferous forest (3.23%), mixed forest (0.42%), moors and heath (0.78% and transitional woodland (5.89%).
3.02	How important is the expected spread of this organism in Ireland by <u>natural</u> means (minimal, minor, moderate, major or massive)?	MODERATE	MEDIUM	As a mobile, territorial species they can move from their area of initial introduction wherever suitable habitat can be reached, although their overall range may be limited by mountain ranges and other natural barriers which may be overcome by human assisted spread (refer to Question 3.03). Home range size of males and females at Chedington, Dorset, England, recorded as 5.2±2.5 and 4.55±2.5 ha, respectively (Johnson, 1982), and median dispersal distances by young females and males of between 1.5 to 3.5 km from natal range (Gaillard <i>et al.</i> 2008). As roe deer home ranges are commonly <10 ha, rates of dispersal by natural means may not be as significant in the short term, as the distance the species may disperse via human assistance.
3.03	How important is the expected spread of this organism in Ireland by <u>human assistance</u> (minimal, minor, moderate, major or massive)?	MODERATE	MEDIUM	In Ireland, any entry and subsequent establishment and spread of roe deer is dependent on deliberate introduction of the species i.e. introduced by man (refer to section stage 2, section A). Deliberate introduction of the species may subsequently lead to translocation to new areas and/or escape or intentional release from captive populations. As deliberate introduction by landholders is considered likely, translocation of roe domestically by humans is considered to be of moderate importance in the expected future spread.

**Stage 2 - Detailed assessment: Section C – Spread**

*This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MODERATE	LOW	<p>In Ireland, the habitats suitable for the establishment and spread of roe deer are varied and constitute a very sizable land cover (refer to Question 3.01) likely making containment of the species majorly difficult if allowed to spread before concerted action is taken. In Britain, the population totals c.500,000 (350,000 in Scotland, 150,000 in England, 50 in Wales (Harris, 1995), with 30,000 culled annually in Scotland (Hewison and Staines, 2008).</p> <p>However, if establishment is noted in time that this remains at a localised level in a small number of areas, containment of their spread would be judged moderately difficult. The low confidence here reflects merely as the level of difficulty is highly dependent on the form and how early on after local / regional establishment an 'eradication campaign' would commence. Given historical prevention of spread and eradication of introduced roe in Ireland in. e.g. Sligo, as well as in parts of England, given the right incentives to local landholders in the event that roe become established, their containment and eradication should be feasible provided early action is taken; i.e. within first 1 to 5 years of establishment or whilst present in small percentage (0 to 5%) of land area.</p>
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	0%-10%	HIGH	Modern day records of roe in Ireland are only beginning to emerge, and the current population (whether it can be considered as established or not) would only be present in 0%-10% of land cover.
3.06	What proportion of the area in Ireland 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%	MEDIUM	It is unlikely for roe to colonise between 0% to 10% within 5 years. Overall as much as 75% of Ireland has suitable habitat for potential spread of roe deer. The common rate of dispersal of young from their natal range lies between 1.5 to 3.5 km,(Gaillard <i>et al.</i> , 2008), although much longer occasional dispersal movements may occur. Therefore, if a breeding population(s) did become established at one or more sites in Ireland, in five years the species might be expected to expand its range by around 15 km at the site(s).

**Stage 2 - Detailed assessment: Section C – Spread**

*This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
3.07	What other timeframe would be appropriate to estimate any significant further spread of the organism (10, 20, 40, 80 or 160 years)? Please comment on why this timeframe is chosen.	10 years	MEDIUM	It seem likely that, provided appropriate vigilance and adequate deterrents to deliberate introductions are maintained , there is no reason to expect establishment of roe to exceed the 0 to 10% level over the next 10 to 20 years. While establishment and spread would be expected to be relatively slow, if allowed to become established in a significant (1 to 5%) proportion of the countryside, the difficulty of eradication would be judged to increase from moderate to major.
3.08	In this timeframe, what proportion of the area (including any currently occupied areas) is likely to have been invaded by this organism?	0 to 10%	MEDIUM	As per answer 3.07, colonisation would not be expected to be rapid, unless multiple deliberate introductions were to occur, without any action at their containment. Much should be possible to learn from the recent introduction of muntjac to Ireland, not least if direct action to monitor and verify all sightings and incentives to control are put in place.
3.09	Based on the answers to questions on the potential for establishment and spread in Ireland, define the area endangered by the organism. Be as specific as possible. If available, provide a map showing the area most likely to be endangered.	-	MEDIUM	Deciduous, mixed and coniferous forestry, moorland, pastures, arable land and suburban areas are most endangered to roe deer invasion/naturalisation.
3.10	Estimate the overall potential for future spread for this organism in (very slowly, slowly, moderately, rapidly or very rapidly). Use the justification box to indicate any key issues.	MODERATELY	MEDIUM	Roe deer occupy a wide variety of habitats and have the potential to establish in about 75% of the Irish landscape, which presents an extremely sizable land cover. During an establishment phase (short-medium term) human assisted spread is likely to be slow and play a greater role in the dispersal of the species than natural spread, but once established in multiple areas further spread would be expected to be moderately fast.

**Stage 2 - Detailed assessment: Section D - Impact**

*This section evaluates the probability of impact of an organism within Ireland.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.01	How great is the economic loss caused by the organism within its global distribution (excluding Ireland), including the cost of any current management?	MINOR	LOW	The species may cause damage to agricultural crops (Packer <i>et al.</i> , 1998; Putman and Moore, 1998) although impacts are highly localised and not of regional or national economic significance (Packer <i>et al.</i> , 1998; Putman <i>et al.</i> , 2003). The species may damage forestry through browsing and fraying young trees, which may delay tree regeneration or establishment, particularly conifers (Gill, 1992a,b; Gill <i>et al.</i> , 2000; Ward <i>et al.</i> , 2004; Welch <i>et al.</i> , 1991). Results from a study by Ward <i>et al.</i> (2004), that modelled the cost of roe deer browsing damage to forestry, suggest that browsing-induced reduction in timber quality (measured as the proportion of trees with multiple-stems at harvest) is not as economically important as some authors have suggested and can be tolerated at high levels (≥55%) if culling is the only method of deer control. Roe deer are the commonest deer involved in road traffic accidents in Europe (Bruinderink and Hazelbroek, 1996; Langbein, 2011; Langbein <i>et al.</i> , 2011).
4.02	How great has the economic cost of the organism been in Ireland from the <u>time of introduction to the present</u> ? Exclude any costs associated with managing the organism from your answer.	N/A	MEDIUM	Modern day records of roe in Ireland are only beginning to emerge (refer to Question 9); currently there are no reported economic costs.
4.03	How great is the economic cost of the organism likely to be in the <u>future</u> in Ireland? Exclude any costs associated with managing the organism from your answer.	MINOR	LOW	If the species were to establish, economic cost are likely to be in line with cost incurred in Britain (refer to Question 4.01).
4.04	How great have the economic costs of managing this organism been in Ireland from the <u>time of introduction to the present</u> ?	N/A	MEDIUM	Modern day records of roe in Ireland are only beginning to emerge (refer to Question 9); currently there are no reported economic costs.
4.05	How great is the economic cost of managing this organism likely to be in the <u>future</u> in Ireland?	MINOR	LOW	If the species were to establish, economic cost are likely to be in line with cost incurred in Britain (refer to Question 4.01). Eradication early on would be likely to prevent increase rise of economic impact from minor to minimal.

**Stage 2 - Detailed assessment: Section D - Impact**

*This section evaluates the probability of impact of an organism within Ireland.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.06	How important is environmental harm caused by the organism within its global distribution?	MINIMAL	LOW	Selective browsing may alter forest species composition (Cederlund, 1998). Highly dependant on population density, (roe) deer browsing may be regarded as beneficial for biodiversity at low density but harmful at high very density.
4.07	How important has the impact of the organism on biodiversity* been in Ireland from the time of introduction to the present? *e.g. decline in native species, changes in community structure, hybridisation	N/A	MEDIUM	Modern day records of roe in Ireland are only beginning to emerge (refer to Question 9); currently there are is reported impact to biodiversity.
4.08	How important is the impact of the organism on biodiversity likely to be in the <u>future</u> in Ireland?	MINIMAL	LOW	Refer to Question 4.06
4.09	How important has alteration of ecosystem function* caused by the organism been in Ireland from the time of introduction to the present? *e.g. habitat change, nutrient cycling, trophic interactions	N/A	MEDIUM	Modern day records of roe in Ireland are only beginning to emerge (refer to Question 9); currently there are no reported alteration to ecosystem functioning.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the <u>future</u> ?	MINIMAL	LOW	Refer to Question 4.06
4.11	How important has decline in conservation status* caused by the organism been in Ireland from the time of introduction to the present? *e.g. sites of nature conservation value, WFD classification, etc.	N/A	MEDIUM	Modern day records of roe in Ireland are only beginning to emerge (refer to Question 9); currently there is no reported decline in conservation status of protected sites or areas of conservation interest.
4.12	How important is decline in conservation status caused by the organism likely to be in the <u>future</u> in Ireland?	MINOR	LOW	Because the species have the potential to establish over such a large area of Ireland (refer o Question 3.01) it is possible that this species will impact on priority species and rarer ground flora found in woodlands of Ireland. Highly dependent on population density, (roe) deer browsing may be regarded as beneficial for biodiversity at low density but harmful at high very density.

**Stage 2 - Detailed assessment: Section D - Impact***This section evaluates the probability of impact of an organism within Ireland.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.13	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within its global distribution?	MAJOR	HIGH	Roe deer are the commonest deer involved in road traffic accidents across Europe (Bruinderink and Hazelbroek, 1996; Langbein, 2011; Langbein <i>et al.</i> , 2011), with over 750,000 roe deer killed in this way per annum, causing also several thousand human injuries and substantial economic costs arising from such collisions.
4.14	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within Ireland?	N/A	MEDIUM	Modern day records of roe in Ireland are only beginning to emerge (refer to Question 9); currently there is no reported social or human harm.
4.15	How important is it that genetic traits of the organism could be carried to other organisms / species, modifying their genetic nature and making their economic, environmental or social effects more serious?	MINIMAL	MEDIUM	European roe deer can hybridise with Siberian roe deer (Hewison and Staines, 2008). No Siberian roe deer are recorded in Britain (the country mostly likely from where any future Irish population will come) therefore, the importance of transfer of genetic traits is minimal.
4.16	How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	MINOR	MEDIUM	Roe deer are considered to be an important mammalian reservoir for <i>Ehrlichia phagocytophila</i> , a bacterium (rickettsia) causing tick-borne fever in sheep and cattle (Hewison and Staines, 2008). They are susceptible to foot and mouth disease under experimental conditions (Forman and Gibbs, 1974) but none found in 2001 outbreak.  There is insufficient data available on the importance of the animal as food; 30,000 are culled in Scotland annually, and many more unreported kills for home consumption (Hewison and Staines, 2008).
4.17	How important might other impacts not already covered by previous questions be resulting from introduction of the organism? Specify in the justification box.	N/A	MEDIUM	We are not aware of any other impacts the introduction of this species would have.
4.18	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 Ireland?	MINOR	MEDIUM	Refer to Question 2.06



**Stage 2 - Detailed assessment: Section D - Impact**

*This section evaluates the probability of impact of an organism within Ireland.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
4.19	Indicate any parts of where economic, environmental and social impacts are particularly likely to occur. Provide as much detail as possible, where possible include a map showing vulnerable areas.	-	MEDIUM	Potential impacts of roe deer in Ireland are mostly likely to be centred in the agricultural, forestry and transport sectors.
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MINOR	LOW	The species may cause damage to agricultural crops (Packer <i>et al.</i> , 1998; Putman and Moore, 1998) and damage forestry through browsing and fraying young trees, which may delay tree regeneration or establishment, particularly conifers (Gill, 1992a,b; Gill <i>et al.</i> , 2000; Ward <i>et al.</i> , 2004; Welch <i>et al.</i> , 1991). The species is prone to involvement in road traffic accidents, given that they are the commonest deer involved in collisions in Europe, (Bruinderink and Hazelbroek, 1996, Langbein, 2011; Langbein <i>et al.</i> , 2011), in particular during spring and early summer when deer are dispersing.

**Stage 2 - Detailed assessment: Section E - Conclusion**

*This section requires the assessor to provide a score for the overall risk posed by an organism, taking into account previous answers to entry, establishment, spread and impact questions.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
5.01	Estimate the overall risk of this organism in Ireland. Noting answers given in 1.11, 2.16, 3.10 & 4.20	MINOR-MODERATE	HIGH	<p>The main pathway is deliberate introduction, as no previous entry of roe via natural colonisation is known. Entry is likely via deliberate introduction. In recent times, roe has been verified as present in Co. Armagh and has been reported in Co. Wicklow (refer to Question 9). The stock is most likely from Britain and most likely as a result of interest in exploitation as a game species. Some shooting/stalking estates like to be able to advertise ability to shoot several different deer species, so that temptation for such illegal release of non-natives game species exists.</p> <p>It is likely that the species could establish, as Ireland shares a similar climate and landscape to Britain where it is already established and widespread. Moreover, introductions are likely to take place in habitats suitable for survival, development and multiplication and roe deer can occupy a wide variety of habitats, including deciduous, mixed or coniferous forests, moorland, pastures, arable land, and suburban areas with large gardens (Hewison and Staines, 2008). Competition with other species or predation for natural enemies has not significantly prevented roe deer from becoming re-established throughout most of England (Hewison and Staines, 2008), which in the event of introduction to Ireland is also likely to be the case. It is likely that the species high breeding rate, adaptability and capacity to spread will facilitate establishment.</p> <p>Roe deer occupy a wide variety of habitats and have the potential to establish in a sizable area of the Irish landscape. During an establishment phase (short-medium term) human assisted spread is likely to be slow and play a greater role in the dispersal of the species than natural spread, but once established in multiple areas further spread would be expected to be moderately fast.</p> <p>The species may cause damage to agricultural crops (Packer <i>et al.</i>, 1998; Putman and Moore, 1998) and damage forestry through browsing and fraying young trees, which may delay tree regeneration or establishment, particularly conifers (Gill, 1992a,b; Gill <i>et al.</i>, 2000; Ward <i>et al.</i>, 2004; Welch <i>et al.</i>, 1991). The species is prone to involvement in road traffic accidents, given that they are the commonest deer involved in collisions in Europe, (Bruinderink and Hazelbroek, 1996, Langbein,</p>

**Stage 2 - Detailed assessment: Section E - Conclusion**

*This section requires the assessor to provide a score for the overall risk posed by an organism, taking into account previous answers to entry, establishment, spread and impact questions.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				2011; Langbein <i>et al.</i> , 2011), in particular during spring and early summer when deer are dispersing.

**Stage 2 - Detailed assessment: Section F – Additional questions**

*This section is used to gather information about the potential effects of climate change on the risk posed by an organism. It is also an opportunity for the risk assessor to highlight high priority research that could help improve the risk assessment.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
6.01	What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	-	HIGH	The species is tolerant of climatic extremes (Mediterranean to Arctic Circle) but snow depth defines northern European limit (Danilkin, 1996). Increases in temperature as a result of climate warming are, therefore, not likely to affect or alter the species' entry, establishment, spread or impact in Ireland. Possibly milder winters and hence better food supply may aid even better survival, but in view of delayed implantation in roe, climate change probably less of factor for roe than for other deer species in Britain and Ireland (Jochen Langbein, per. comm., 24 <sup>th</sup> March 2014).
6.02	What is the likely timeframe for such changes (5, 10, 15, 20, 50 or 100 years)?	N/A	N/A	Refer to Question 6.01
6.03	What aspects of the risk assessment are most likely to change as a result of climate change	-	N/A	Refer to Question 6.01
6.04	If there is any research that would significantly strengthen confidence in the risk assessment, please note this here. If more than one research area is provided, please list in order of priority.	-	HIGH	Research is needed to confirm whether the current records/sightings of roe in Ireland represent an established population i.e. breeding population. Modelling of the species potential rate of spread and likely distribution in Ireland would significantly strengthen the confidence in this risk assessment.  Much research continues to be done in particular by the French National Institute for Agricultural Research (INRA) on the dispersal rates and mortality factors in roe deer (already referred to in the assessment). Roe deer are possibly the best and most widely studied deer species across Europe. Perhaps rather than referencing single ongoing research areas, a useful source bringing together research and researchers on roe deer from over 25 separate research groups has been set-up in "Eurodeer", and should remain a valuable source going into the future : see <a href="http://www.eurodeer.org/">http://www.eurodeer.org/</a> .

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