Risk Assessment of *Strix aluco*

Name of Organism:	*Strix aluco* Linnaeus, 1758 – Tawny Owl
Objective:	Assess the risks associated with this species in Ireland
Version:	Final 15/09/2014
Author(s)	Erin O'Rourke, Liam Lysaght
Expert reviewer	John Lusby

Stage 1 - Organism Information

Stage 2 - Detailed Assessment
Section A - Entry
Section B - Establishment
Section C - Spread
Section D - Impact
Section E - Conclusion
Section F - Additional Questions

About the risk assessment

This risk assessment is based on the **N**on-native species **AP**plication based **R**isk **A**nalysis (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

Name of Document:	Risk Assessment of *Strix aluco*				
Author (s):	Dr Erin O'Rourke and Dr Liam Lysaght				
Authorised Officer:	Dr Liam Lysaght				
Description of Content:	Non-native species risk assessment				
Approved by:	Dr Liam Lysaght				
Date of Approval:	15/09/2014				
Assigned review period:	n/a				
Date of next review:	n/a				
Document Code	n/a				
This documents comprises	TOC	Text	List of tables	List of Figures	No. Appendices
	n/a	YES	n/a	n/a	n/a

Version Control Table

Version No.	Status	Authors(s)	Reviewed by	Approved by	Date of issue
Draft 1	Complete	Dr Erin O'Rourke	Dr Liam Lysaght		20/03/2014
Expert review	Complete	Dr Erin O'Rourke	Dr John Lusby	Dr Liam Lysaght	17/04/2014
Public consultation	Complete	Dr Erin O'Rourke		Dr Liam Lysaght	09/05/2014
Expert review 2	Complete	Dr Erin O'Rourke	Dr John Lusby	Dr Liam Lysaght	26/07/2014
Public consultation 2	Complete	Dr Erin O'Rourke		Dr Liam Lysaght	14/08/2014
Final	Complete	Dr Erin O'Rourke		Dr Liam Lysaght	15/09/2014

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	*Strix aluco* Linnaeus, 1758 – tawny owl Taxonomy: Kingdom: Animalia Phylum: Chordata Subphylum: Vertebrata Class: Aves Order: Strigiformes Family: Strigidae Genus: Strix Species: aluco Synonyms: n/a Common name (English): tawny owl The tawny owl has separate European and Asiatic populations (Figure 1; Petty and Saurola, 1997). The subspecies are poorly differentiated and as a consequence 10-15 subspecies have been historically described (Voous and Cameron, 1988). Currently there are eleven recognised subspecies: *S. a. aluco*, in northern and central Europe from Scandinavia to the Mediterranean and Black Sea; *S. a. mauritanica*, in northwestern Africa from Morocco to Tunisia and Mauritania; *S. a. sylvatica*, in western Europe including Britain; *S. a. siberiae*, in central Russia from the Urals to western Siberia; *S. a. sanctinicola*, in western Iran and northwest Iraq; *S. a. wilkonskii*, from Palestine to northern Iran and the Caucasus; *S. a. harmsi*, in Turkmenistan; *S. a. bidulphi*, in northwestern India and Pakistan (WOT, 2005).
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.	-	Diaz (2011) describes tawny owls as “medium-sized and compact” owls. They have large, rounded heads and lack ear tufts. The species exhibits geographic variation in colour, ranging from rufous or greyish-brown with mottled plumage, finely streaked, and with dark vermiculation (more commonly seen in the eastern part of the birds range); or lighter grey and white (in the northernmost parts of their distribution). Females are more than 25% heavier and 5% longer than males across all subspecies. Siberian and Scandinavian subspecies are 12% larger and 40% heavier than western European tawny owls, with 13% longer wings. South and east Asian subspecies have barred as opposed to striped undersides and have fine facial disk lines .In all subspecies the facial discs are usually plain, with pale, whitish crown-stripes or extra “eyebrows”. The tail is finely barred. The eyes are black, which is in contrast to the yellow eyes of long-eared owls with which there is overlap in terms of distribution and habitat use. The shoulder feathers are lined with white spots and the inner primary feathers lack pale markings. Juveniles are paler than adults. In flight tawny owls have quick wing beats and glide long and straight on broad wings. Great grey owls, eagle owls and Ural owls resemble tawny owls in shape, but are much larger.” Peterson *et al.* (2004) describes the tawny owl’s song as a “deep musical hoo-hoo-hoo, followed at an interval by a long, tremulous oo-oo-oo-oo” and it’s shrill as a “ke-wick”.
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	NO	
6	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	N/A	
7	Where is the organism native?	-	The species is native to Afghanistan; Albania; Algeria; Andorra; Armenia (Armenia); Austria; Azerbaijan; Belarus; Belgium; Bhutan; Bosnia and Herzegovina; Britain; Bulgaria; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; India; Iran, Islamic Republic of; Iraq; Israel; Italy; Jordan; Kazakhstan; Korea, Democratic People's Republic of; Korea, Republic of; Kyrgyzstan; Latvia; Lebanon; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Yugoslav Republic of; Moldova; Montenegro; Morocco; Myanmar; Nepal; Netherlands; Norway; Pakistan; Palestinian Territory, Occupied; Poland; Portugal; Romania; Serbia (Serbia); Slovakia; Slovenia; Spain; Sweden; Switzerland; Syrian Arab Republic; Taiwan, Province of China; Tajikistan; Tunisia; Turkey; Turkmenistan; Ukraine; Uzbekistan; Vietnam (Figure 1; BLI, 2012)

Stage 1 - Organism Information

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

N	QUESTION	RESPONSE	COMMENT
			 **Figure 1.** Native range of tawny owl (*Strix aluco*; modified from BLI, 2012).
8	What is the current global distribution of the organism (excluding Ireland)? (map optional)	-	The tawny owl's main distribution lies within the temperate forest zone and extends into boreal and Mediterranean habitats, i.e. the Palaearctic (Figure 1; Huntley *et al*., 2007; Petty and Saurola, 1997). It is absent from Iceland, the Northern islands and isles of Scilly in Britain, Ireland, the Atlantic islands and most Mediterranean islands, the notable exception being Sicily (Balmer *et al*., 2013; Huntley *et al*, 2007). Outside Europe it breeds in north-west Africa, Turkey, the Middle East, northern Iran and west Siberia, as well as discontinuously across southern Asia through the Himalayas to China, Korea and Taiwan (Figure 1; Huntley *et al*, 2007).

Stage 1 - Organism Information *The aim of this section is to gather basic information about the organism.*			
N	**QUESTION**	**RESPONSE**	**COMMENT**
9	What is the current distribution of the organism in Ireland? (map optional)		Tawny owls are absent from Ireland, although a bird presumed to be wild was present in Co. Down in 2013 (Figure 1; Balmer *et al*., 2013). There have also been unconfirmed reports of a bird in County Kerry in recent years.
10	Is the organism known to be invasive anywhere in the world?	NO	The tawny owl is not documented 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), but it is however an aggressive species and may compete with or displace smaller owl species through direct predation or via competition for prey and nest sites (Diaz, 2011). There is evidence that tawny owl may displace barn owls in urban areas, by taking over their nests within buildings (Diaz, 2011; Voous and Cameron, 1988) There are four species of owl which occur in Ireland (Balmer *et al*., 2013). The long-eared owl is the most abundant and widespread resident (Balmer *et al*., 2013; Lusby *et al*., 2012; O'Clery *et al*., 2012). This species breeds throughout a range of lowland and agricultural habitats in Ireland, with a preference for woodland (Balmer *et al*., 2013; Lusby *et al*., 2012), which is also the primary habitat of the tawny owl (Balmer *et al*., 2013). Long-eared owls are abundant throughout central Europe corresponding to the distribution of temperate broad-leaved forest (Petty and Saurola, 1997), which highlights the species' habitat preference. As woodland birds, the long-eared owl and the tawny owl have similar habitat requirements (Balmer *et al*., 2013). However, the tawny owl is considered competitively dominant (Balmer *et al*., 2013; Glue and Nilsson, 1997) and as such tawny owl may impact local population densities of long-eared owl. Long-eared owl densities are likely to be higher in Ireland compared to neighbouring UK and this may be partly related to the absence of tawny owl (Balmer *et al*., 2013; Glue and Nilsson, 1997; Scott, 1997). In Britain a decrease in long-eared owl since 1990 has been attributed partly to competition for food and nest sites with the expanding population of the tawny owl (Glue and Nilsson, 1997). Because of the tawny owl's competitive dominance the potential establishment of this species in Ireland may negatively impact upon the long-eared owl population. The barn owl is a widely distributed but scarce resident throughout Ireland, with the south and mid-west and midlands being the main stronghold for the population (Lusby, 2012). It is Red Listed on the Birds of Conservation Concern in Ireland (BoCCI) (Colhoun & Cummins, 2013)). The species breeds in ruined buildings such as castles, churches and farm houses, as well as mature trees with hollow cavities and will also take to artificial nest boxes (Lusby, 2012) . Densities and breeding success is heavily dependent on habitat quality and the availability of suitable prey (Shawyer, 1988; Taylor, 1994). The tawny owl is known to have a remarkable ability to adapt to habitats made or altered by human beings (Galeotti, 1990; Petty, 1992). It has colonised many urban areas and has adapted to live in virtually treeless tracts created by deforestation and the rise of intensive agriculture (Petty and

Stage 1 - Organism Information *The aim of this section is to gather basic information about the organism.*			
N	**QUESTION**	**RESPONSE**	**COMMENT**
			Saurola, 1997). Although it prefers to breed in tree cavities, the tawny owl is extremely adaptable and will use a wide range of alternative nest sites, including buildings, crag ledges, other species' stick nests and may even nest on the ground (Peterson *et al*., 2004; Petty and Saurola, 1997). Because of the adaptive nature of the tawny owl, both in habitat and nesting requirements, the potential establishment of this species in Ireland may negatively impact upon the sensitive barn owl population (Voous and Cameron, 1988). The snowy owl is a rare winter visitor to Ireland and is not a regular breeding species in Ireland (BWI, 2014d). The short-eared owl is a scarce winter visitor but may breed in low numbers in upland habitats mainly in the south-west (Jones, 1979). The snowy and short-eared owl are Annex I species under the Birds Directive (Council Directive 79/409/EEC) and both species are also Amber Listed for medium conservation concern nationally. However both species have different habitat requirements to that of tawny owl and establishment of tawny owl is therefore not considered to impact or pose a threat to either species. Although the tawny owl is not documented as an invasive species in its current range, its presence in Ireland has the potential to negatively impact upon two native owl species. Tawny owls are fiercely protective of nests and any potential intruder may be attacked by the species, including humans although this is a rare occurrence (Voous and Cameron, 1988).

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 active or future pathways relevant to the entry of the tawny owl.
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/accidental introduction 2. Natural colonisation	HIGH	The most relevant future pathway to the potential entry of the species is one of introduction by humans, either deliberate or accidental. Deliberate introductions would most likely to be from established populations in Britain (i.e. the subspecies *S. a. sylvatica*) or captive birds in Ireland. Deliberate introduction of the species may subsequently lead to dispersal of the species i.e. translocation to new areas and/or escape or intentional release from captive populations. Tawny owls are known to be non-migratory birds (Diaz, 2011). They are highly territorial and sedentary (Huntley *et al*., 2007; Petty and Saurola, 1997). Post-fledging movements are small, with most juveniles eventually settling to breed within 20 km of where they hatched, but avoiding their natal territory (Petty, 1992). Movements of birds from resident populations in Britain to Ireland are considered to have been limited in the past, which is influenced by the dispersal and ranging behaviour of this species. However, although movements of juveniles during the post-fledging phase are generally short and dispersal across the Irish Sea is likely to be very rare, it cannot be ruled out as a potential pathway, particularly in light of the increasing population in Britain (Balmer et al., 2013) which may be reaching carrying capacity These are the only potential pathways considered relevant for this species.

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 the species via this pathway is intentional i.e. introduced by man. It is likely that introductions would be as ornamental animals for perceived 'landscape improvement' or from escaped captive birds held by falconers, in private collections and/or zoos. Popular culture may play a hand in the deliberate introduction of tawny owls; as films such as Harry Porter, which feature owls, may increase popularity of birds as possible pets.
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	MEDIUM	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 i.e. at present a specific licence is not required in Ireland to keep owl species. The number of tawny owls potentially entering Ireland via a future pathway of deliberate introduction would be expected to be low, infrequent and dependent on the demand for the species by avian enthusiasts.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	LIKELY	MEDIUM	It is likely that this species could enter Ireland without the knowledge of the competent authorities. This assumption is somewhat substantiated by the recordings of other non-native species 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?	MODERATELY LIKELY	MEDIUM	It is likely that the species nutrimental and housing requirements would be catered for by the importer.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	MEDIUM	Establishment success would be initially dependent on the introduction of one sexually mature tawny owl of each sex, or more than one pregnant female, to a suitable habitat during the breeding season. The breeding season is from January to July (Diaz, 2011). It is likely for the species to arrive during these months of the year most appropriate for establishment. However, arrival at any stage of the year could also lead to establishment as birds could survive during the non-breeding season based on their natural distribution and habitat preferences and availability in Ireland

Pathway 1 – Deliberate introduction				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	The tawny owl 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. Tawny owls occupy a wide variety of habitats, including open deciduous, mixed or coniferous forests, agricultural areas with trees, parks, cemeteries and large gardens, preferring locations with access to water (Diaz, 2011; Huntley *et al*., 2007; Peterson *et al*., 2004; Petty and Saurola, 1997). Tawny owls are frequently found near human habitats (for example in central London) and in winter can be found nesting in abandoned buildings and rock cavities (Diaz, 2011; Galeotti, 1990; Petty, 1992). Of these varied habitats types the tawny owl has a preference for broad-leaved forest (Diaz, 2011; Petty and Saurola, 1997; Southern 1970). 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?	MODERATELY LIKELY	MEDIUM	Entry is moderately likely via deliberate introduction. If the species were to enter Ireland the birds would most likely come from Britain and most likely be as ornamental animals for perceived 'landscape or species diversity improvement' or as holdings within private wildlife collections or by falconers.
1.10	Do other pathways need to be considered?	YES	HIGH	

Pathway 2 – Natural colonisation				
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)?	NO	VERY HIGH	Natural colonisation would not be intentional or accidental.

Pathway 2 – Natural colonisation				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
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?	MODERATELY LIKELY	MEDIUM	The tawny owl is highly territorial and sedentary (Huntley *et al.*, 2007; Petty and Saurola, 1997). Post-fledging movements are small, with most juveniles eventually settling to breed within 20 km of where they hatched, but avoiding their natal territory (Petty, 1992). There have been recorded movements of barn owl, which has similar dispersal ecology to the tawny owl, from the UK to Ireland. Although the species has apparently not yet colonised Ireland despite the availability of suitable habitat, natural colonisation has to be considered as a possibility, particularly in light of the increasing population in Britain. These factors taken into account, it is considered moderately likely that tawny owl may naturally colonise Ireland from populations in Britain in the future.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	VERY LIKELY	HIGH	It is very likely that this species could enter Ireland without the knowledge of the competent authorities. This assumption is somewhat substantiated by the recordings of other recent colonists and non-native species in Ireland; indicating that successful colonisations have taken place without the initial knowledge of the competent authorities.
1.06	How likely is the organism to survive during passage along the pathway?	LIKELY	MEDIUM	Birds would be able to survive short crossings from the UK to Ireland. Movements of barn owl across the Irish Sea have previously been recorded.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	VERY LIKELY	HIGH	Arrival would most likely occur during the post-fledging period when birds are dispersing. However, based on the availability of suitable habitat, it is very likely that colonising birds could survive at any time of the year.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	VERY LIKELY	HIGH	The tawny owl 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. Tawny owls occupy a wide variety of habitats, including open deciduous, mixed or coniferous forests, agricultural areas with trees, parks, cemeteries and large gardens, preferring locations with access to water (Diaz, 2011; Huntley *et al.*, 2007; Peterson *et al.*, 2004; Petty and Saurola, 1997). Tawny owls are frequently found near human habitats (for example in central London) and in winter can be found nesting in abandoned buildings and rock cavities (Diaz, 2011; Galeotti, 1990; Petty, 1992). Of these varied habitats types the tawny owl has a preference for

Pathway 2 – Natural colonisation				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
				broad-leaved forest (Diaz, 2011; Petty and Saurola, 1997; Southern 1970). The species is likely to 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?	MODERATELY LIKELY	LOW	It is considered moderately likely that small numbers of individuals from the expanding UK population may disperse to Ireland, however less likely that these individuals would encounter each other and establish a viable breeding population.
1.10	Do other pathways need to be considered?	NO	MEDIUM	

Overall likelihood				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.11	Estimate the overall likelihood of entry into Ireland based on all pathways (comment on the key issues that lead to this conclusion).	MODERATELY LIKELY	MEDIUM	Entry is moderately likely via deliberate introduction. If the species were to enter Ireland the birds would most likely come from Britain and most likely be as ornamental animals for perceived 'landscape or species diversity improvement' or as holdings within private wildlife collections or by falconers. It is considered moderately likely that small numbers of individuals from the expanding UK population may naturally disperse to Ireland, however less likely that these individuals would encounter each other and establish a viable breeding population.

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
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	NO	HIGH	Tawny owls have not been confirmed breeding in Ireland, although a bird presumed to be wild was present in Co. Down in 2013 (Figure 1; Balmer *et al.*, 2013). There have also been unconfirmed reports of a bird in County Kerry in recent years.
2.02	How likely is it that the organism will be able to establish in Ireland based on the similarity between local climatic conditions and the organism's current global distribution?	VERY LIKELY	HIGH	The majority of the tawny owl's geographical range falls within the temperate climatic zone (Figure 1). This species breeds in Europe principally where annual temperature sum exceeds ca. 800 degree days above 5ºC, although extending sparsely to areas with as few as ca. 200 degree days (Huntley *et al.*, 2007). It is absent where coldest month mean temperatures are less than ca. -0ºC (Huntley *et al.*, 2007). Its distribution spans the entire range of moisture availability found in Europe, although it is less frequent in areas with more marked seasonal moisture deficiency (AET/PET ≤0.5) (Huntley *et al.*, 2007). 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). The species is widespread across Britain (Peterson *et al.*, 2004), Ireland's nearest and climatically similar neighbour. Tawny owl populations also extend into the polar and tropical zones (Figure 1), which highlight the species' current northerly and southerly range limits.
2.03	How likely is it that the organism will be able to establish in Ireland based on the similarity between other local abiotic conditions and the organism's current global distribution?	VERY LIKELY	HIGH	It is very likely that the abiotic conditions in Ireland will be favourable to the establishment of the tawny owl, especially given that the species is well established and widespread in the Britain (Peterson *et al.*, 2004) where climatic conditions (refer to Question 2.02) and habitat availability (refer to Question 2.04) are comparable. The tawny owl is a 'sit and wait' hunter, not well-adapted to exploit alternative prey at these crucial times of year and low numbers of small mammals result in few owl pairs breeding (Petty and Saurola, 1997). The abundance and distribution of small mammals (particularly voles and mice) are of prime importance, especially throughout winter and early spring (Petty and Saurola, 1997). It may exploit alternative prey such as recently fledged birds, amphibians, arthropods and other mammals, but later in spring and summer (Petty and Saurola, 1997). Its principal

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
				requirement is for richly structured habitat offering look-out posts, open or partially open areas for hunting and ample prey (Huntley *et al*., 2007; Southern, 1970; Petty, 1992). They are lowland birds in colder parts of their rage but can breed at higher altitudes (Diaz, 2011).
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 deliberately introduced to Ireland, introductions are likely to take place in habitats suitable for survival, development and multiplication of the species. The tawny owl's primary habitat is broad-leaved forest (Diaz, 2011; Petty and Saurola, 1997; Southern 1970). It is also found in many other woodland habitats including mixed conifer and broad-leaved forests, subalpine conifer forests and conifer plantations (Peterson *et al*., 2004; Petty and Saurola, 1997; Huntley *et al*., 2007). The species has shown a remarkable ability to adapt to habitats made or altered by human beings (Galeotti, 1990; Petty, 1992). It has colonised many urban areas and has adapted to live in virtually treeless tracts created by deforestation and the rise of intensive agriculture (Petty and Saurola, 1997; Huntley *et al*., 2007). Although it prefers to breed in tree cavities, the tawny owl is extremely adaptable and will use a wide range of alternative nest sites, including buildings, crag ledges, other species' stick nests and may even nest on the ground (Petty and Saurola, 1997; Peterson *et al*., 2004). The species is likely to be introduced and/or encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000).
2.05	How likely isit that establishment will occur despite competition from existing species in Ireland?	VERY LIKELY	HIGH	Competition with the Ural and eagle owl is reported (Petty and Saurola, 1997; Voous and Cameron, 1988). For example, during the 1920s and 1930s in Finalnd the tawny owl expended its range northwards, in broad-leaved forests along coastal and riparian zones, and in arable areas from which the Ural owl was absent (Lungberg, 1980). The Ural and eagle owl are, however, not present in Ireland. In Britain competition with existing species is not reported to have prevented tawny owl from becoming established. With reference to Question 10, if the tawny owl was to establish in Ireland it is possible that the species will be competitively dominant over native owl species.

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
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?	LIKELY	MEDIUM	Tawny owls are preyed on by larger birds such as northern goshawks and common buzzards (Voous and Cameron, 1988). They also compete with and are preyed upon by other species of owls such as Ural and eagle owls, however these species do not occur in Ireland (refer to Question 2.05). Pine martens, which are widespread in Ireland, are known to raid owl nests and humans supplying of artificial nesting boxes in urban areas makes owl fledgling more susceptible to predation (Voous and Cameron, 1988). Eurasian jackdaws sometimes build nests on top of female tawny owls, killing both adult and chicks (Voous and Cameron, 1988). A study by Sunde (2005) revealed foxes (and other mammalian predators) as a prime factor in the mortality rates of fledgling tawny owls: 36% of fledglings dies within the first 55 days of leaving the nest. Predation increases by over 44% as the year progresses, providing selection pressure for early breeding (Sunde, 2005). Avian predators such as raptors pose the second biggest threat to juveniles (Sunde, 2005). Tawny owls are affected by several kinds of blood parasites, including *Leucocytozoon*, *Haemoproteus* and *Trypanosoma* (Galeotti and Sacchi, 2003). These parasites negatively affect the fitness of the afflicted bird and breeding behaviours within the morphs, with the rufous morph most susceptible because of their open habitat and greater exposure (Galeotti and Sacchi, 2003). With reference to the widespread establishment of the species in Britain, potential establishment of the tawny owl in Ireland is not expected to be significantly prevented by predators, parasites or pathogens.
2.07	How likely is it that establishment will occur despite existing management practices?	N/A	N/A	As tawny owl are not known to be present in Ireland there are no management practices geared towards control of the species. Therefore, it is unknown how likely establishment will be despite the implementation of management practices.

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
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?	LIKELY	MEDIUM	The Tawny owl has increased its range and density in Britain as a result of upland area reforestation (Petty, 1992). Increases in the Netherlands and Belgium are related to the maturation of forests planted since the 1890s (Petty and Saurola, 1997). Afforestation, reforestation and maturation of existing forestry are management practices within the forestry sector which are likely to facilitate tawny owl establishment. Agriculture enterprises which maintain a patchwork of linear hedgerows are also likely to aid establishment of the species.
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?	LIKELY	LOW	The non-migratory, sedentary nature and territoriality, in particular the bird's vocal communication, would facilitatelocation and control. Conversely, tawny owls defend their nest and young fiercely, striking with sharp falons at intruders head and eyes, and their silent flight give them the ability to attack without notice (Diaz, 2011). However, the nocturnal nature of the tawny owl may allow for the bird to remain elusive, and detection rates may be low when if the species were to occur in low densities which may also reduce the necessity for territorial behaviour If the species were to establish in Ireland, these characteristics are likely to both aid and hinder eradication. Central to an eradication campaign would be the support from the bird-watching community; asking them to report the presence of such territorial birds.
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?	LIKELY	MEDIUM	Tawny owls breed once a year, which occurs from January and July and produces an average of 2-3 eggs (Diaz, 2011). Tawny owls invest heavily in their chicks. Once the eggs have hatched after about 30 days, males bring food to the nest and females leave the nest only to hunt once the downy, altricial chicks are several days old and for most of the time remain close to the brood (Lewis, 2013; Snow and Perrins, 1998). Even after fledging (35-39 days), juveniles depend on their parents for food for 2-3 months (Lewis, 2013; Snow and Perrins, 1998). Around August to November, young owls must leave to find their own hunting territories and fend for themselves or risk starving to death (Lewis, 2013; Snow and Perrins, 1998). Heavy investment in offspring development is a reproductive trait of tawny owls that may facilitate establishment. However, a study by Leighton *et al.* (2008) highlighted post-release survival rates of hand-reared tawny owls to be low: 66% survived longer

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
				than 6 weeks, only 39% survived over a year and just one bird survived longer than the average 4 year lifespan of wild tawny owls.
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?	MODERATELY LIKELY	MEDIUM	The tawny owl is highly territory and sedentary (Huntley *et al*., 2007; Petty and Saurola, 1997). Post-fledging movements are small, with most juveniles eventually settling to breed within 20 km of where they hatched, but avoiding their natal territory (Petty, 1992). Once established, most adults retain a territory for life (Diaz, 2011). In prime habitats, average territory size can be as small as 10-12ha, but in poorer habitats as much as 60-70ha (Galeotti, 1990; Petty, 1992). As such it is moderately likely that the species' capacity to spread will facilitate establishment.
2.12	How likely is it that the organism's adaptability will facilitate its establishment?	LIKELY	MEDIUM	Tawny owl is considered highly adaptable (Diaz, 2011; WOT, 2005). The species is adaptive to varying climatic conditions (refer to Question 2.02) and a range of habitat and nesting sites (refer to Question 2.04)
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?	LIKELY	LOW	Given that tawny owls form monogamous pairs for life (Lewis, 2006; Snow and Perrins, 1998), low genetic diversity in the founder population is not likely to hinder establishment.
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	MEDIUM	As the species is not considered invasive there is no history of invasion. If introduced to 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?	LIKELY	MEDIUM	Tawny owls are absent from Ireland, although a bird presumed to be wild was present in Co. Down in 2013 (Balmer *et al*., 2013), which may highlight the potential for short-lived individuals or populations to occur in Ireland, most likely under less favoured habitat and climatic conditions.

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	MEDIUM	The species is highly adaptive. If introduced 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. Introductions are likely to take place in habitats suitable for survival, development and multiplication and tawny owls can occupy a wide variety of habitats, including open deciduous, mixed or coniferous forests, agricultural areas with trees, parks, cemeteries and large gardens (Diaz, 2011; Huntley *et al*., 2007; Peterson *et al*., 2004; Petty and Saurola, 1997).The species is likely to be introduced and/or encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000). Competition with other species or predation for natural enemies has not been reported to have significantly prevented tawny owl from becoming established in Britain, which in the event of introduction to Ireland is also likely to be the case. Forestry management practices (e.g. afforestation, reforestation and maturation of existing forestry) may aid species establishment on the island.

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%	LOW	Tawny owls occupy a wide variety of habitats, including open deciduous, mixed or coniferous forests, agricultural areas with trees i.e. hedgerows, parks, cemeteries and large gardens, but have a preference for deciduous woodland (Diaz, 2011; Huntley *et al*., 2007; Peterson *et al*., 2004; Petty and Saurola, 1997). The species has shown a remarkable ability to adapt to habitats made or altered by human beings (Galeotti, 1990; Petty, 1992). With refer to the CORINE (2006) land cover classification tawny owls, as terrestrial woodland species, have the potential to establish in about 10% of the Irish landscape - broad leaved forest (0.41%), coniferous forest (3.23%), mixed forest (0.42%), and transitional woodland (5.89%). Of note is that the tawny owl preferred habitat of broad-leaved constitutes the least amount of overall forest cover in Ireland. It is of note that CORINE land cover data does not specifically account for specific habitat features such as parks, cemeteries and large gardens, or linear features, e.g. hedgerows, <100m in width, which represent important terrestrial breeding and wintering habitat for the species. These habitat features are encompassed within the following habitat types measure by CORINE: green urban areas (0.04%), non-irrigated arable land (7.53%), pastures (50.53%) and natural grassland (1.26%; CORINE, 2006) It is suspected that even if these habitat features, in addition to forestry cover, where accounted for the area in Ireland that the species has the potential to establish would amount to 68%-90%. This potential percentage land range would also be reflective of the distribution of tawny owl in Britain. Tawny owl were recorded in 76% of 10km survey squares in the UK through the Breeding Birds Atlas 2007 – 2011 (Balmer et al. 2013).
3.02	How important is the expected spread of this organism in Ireland by natural means (minimal, minor, moderate, major or massive)?	MAJOR	LOW	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). The tawny owl is highly territory and sedentary (Huntley *et al*., 2007; Petty and Saurola, 1997). Post-fledging movements are small, with most juveniles eventually settling to breed within 20 km of where they hatched, but avoiding their natal territory (Petty, 1992). Once established, most adults retain a territory for life (Diaz, 2011). In prime

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
				habitats, average territory size can be as small as 10-12ha, but in poorer habitats as much as 60-70ha (Galeotti, 1990; Petty, 1992). Once established it would be expected for natural spread to be of major importance to the dispersal of the species.
3.03	How important is the expected spread of this organism in Ireland by human assistance (minimal, minor, moderate, major or massive)?	MINIMAL	LOW	In Ireland, any entry and subsequent establishment and spread of tawny owl 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 avian populations. During the initial stages of any potential establishment human assisted dispersal is likely to play a greater role in the spread of the species compared to natural spread. Once established it would be expected for human assisted spread to be of minimal importance to the dispersal of the species.
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MAJOR	LOW	In Ireland, the habitats suitable for the establishment and spread of tawny owl are varied and constitute a sizable land cover (refer to Question 3.01) likely making containment of the species moderately difficult. In Europe, the breeding population is estimated to number 480,000-1,000,000 breeding pairs, equating to 1,440,000-3,000,000 individuals (BLI, 2012).
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	N/A	N/A	To-date, the species is not known to be established in Ireland.
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%	LOW	If the species were to become established, in the absence of specific data on colonisation rates for this species, based on its breeding and dispersal ecology, the availability of suitable habitats in Ireland and rates of colonisation for other predatory avian species in Ireland (e.g. common buzzard) it is considered that 0-10% of the Irish land cover could be colonised within five years.

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
3.07	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.	40	LOW	With the increasing tawny owl population in the UK, dispersal and colonisation to Ireland may become more likely over time.
3.08	In this timeframe, what proportion of the area (including any currently occupied areas) is likely to have been invaded by this organism?	11 – 33%	LOW	
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.	-	LOW	Deciduous, mixed and coniferous forestry, hedgerow networks, parks, cemeteries and large gardens are most endangered to tawny owl invasion/naturalisation. The east coast of Ireland is the most likely point of origin of any naturally established population based on proximity to the UK. If tawny owl were to become established through deliberate introduction then this could occur anywhere in Ireland.
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.	RAPIDLY	LOW	Tawny owls occupy a variety of habitats and have the potential to establish over the majority of the Irish landscape. During an establishment phase (short-medium term) human assisted spread is likely to play a greater role in the dispersal of the species than natural spread. Also once colonised the tawny owl would disperse naturally and human assisted spread would not be as important

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?	N/A	N/A	To the authors knowledge there are no reported negative economic impacts of the tawny owl within its global distribution. Similarly there are no major positive economic impacts aside from preying upon small animals that may be considered agricultural pests (Diaz, 2011).
4.02	How great has the economic cost of the organism been in Ireland from the time of introduction to the present? Exclude any costs associated with managing the organism from your answer.	N/A	N/A	To-date, the species is not known to be established in Ireland.
4.03	How great is the economic cost of the organism likely to be in the future in Ireland? Exclude any costs associated with managing the organism from your answer.	-	-	There are insufficient data available at present to forecast economic losses due to possible negative impacts/damage by this species. It would be expected that the costs incurred would only be in relation to management (monitoring and possibly control/eradication) of the species, research costs to determine potential impacts and interactions with native species and increased resources for conservation action for native species.
4.04	How great have the economic costs of managing this organism been in Ireland from the time of introduction to the present?	N/A	N/A	To-date, the species is not known to be establishedin Ireland.
4.05	How great is the economic cost of managing this organism likely to be in the future in Ireland?	-	-	There are insufficient data available at present to forecast economic losses due to possible negative impacts/damage by this species. It would be expected that the costs incurred would only be in relation to management (monitoring and control/eradication) of the species, research costs to determine potential impacts and interactions with native species and increased resources for conservation action for native species.

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?	N/A	N/A	There are no reported negative environmental impacts.
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	N/A	To-date, the species is not known to be established in Ireland.
4.08	How important is the impact of the organism on biodiversity likely to be in the <u>future</u> in Ireland?	MODERATE	LOW	Establishment and spread of the tawny owl may negatively impact upon native owl species. As woodland birds, the long-eared owl and the tawny owl have common breeding-season habitat (Balmer *et al*., 2013). However, the tawny owl is considered competitively dominant (Balmer *et al*., 2013; Glue and Nilsson, 1997) and as such both species are not likely to coexist without impacts on the Long-eared Owl population. Because of the tawny owl's competitive dominance the potential establishment of this species in Ireland may negatively impact upon densities of long-eared owl's Irish population, but should not affect its conservation status to the point of extinction. The barn owl is a widely distributed but scarce resident throughout Ireland, with the south and mid-west and midlands being the main stronghold for the population (Lusby, 2012). It is Red Listed on the Birds of Conservation Concern in Ireland (BoCCI) (Colhoun & Cummins, 2013)). The species breeds in ruined buildings such as castles, churches and farm houses, as well as mature trees with hollow cavities and will also take to artificial nest boxes (Lusby, 2012 . Densities and breeding success is heavily dependent on habitat quality and the availability of suitable prey (Shawyer, 1988; Taylor, 1994). The tawny owl is known to have a remarkable ability to adapt to habitats made or altered by human beings (Galeotti, 1990; Petty, 1992). It has colonised many urban areas and has adapted to live in virtually treeless tracts created by deforestation

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

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				and the rise of intensive agriculture (Petty and Saurola, 1997). Although it prefers to breed in tree cavities, the tawny owl is extremely adaptable and will use a wide range of alternative nest sites, including buildings, crag ledges, other species' stick nests and may even nest on the ground (Peterson *et al*., 2004; Petty and Saurola, 1997). Because of the adaptive nature of the tawny owl, both in habitat and nesting requirements, the potential establishment of this species in Ireland may negatively impact upon the vulnerable barn owl population (Voous and Cameron, 1988). Population densities and ecological requirements of barn owls in Ireland differ to other European populations and therefore it is difficult to predict the impacts of the colonisation of tawny owl, however based on both species having overlapping distributions in other parts of their range, it is unlikely that tawny owl would impact barn owl populations to the point of extinction in Ireland.
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	N/A	To-date, the species is not known to be present in Ireland.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the future?	-	-	There are insufficient data available at present to forecast alteration of ecosystem function caused by this species.
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	N/A	To-date, the species is not known to be established in Ireland.
4.12	How important is decline in conservation status caused by the organism likely to be in the future in Ireland?	-	-	There are insufficient data available at present to forecast how important is decline in conservation status caused by the organism likely to be in the future. Because the species have the potential to establish over the majority of the Irish landscape (refer o Question 3.01), it is possible for the species to potentially impact upon the conservation status, i.e. native species and/or indigenous habitat, of a particular area.

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?	MINIMAL	LOW	Because of their fierce protectiveness of nests, any potential intruder may be attacked by the species, including humans (Voous and Cameron, 1988). This is, however, a rare occurrence.
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	N/A	To-date, the species is not known to be established in Ireland.
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?	MINOR	HIGH	Hybridisation of tawny owl with the resident species of owl in Ireland has not been recorded elsewhere throughout its range.
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)?	-	-	There is insufficient data to effectively determine the potential impact of tawny owl acting as a host, symbiont or vector of damaging organisms which may impact native or established species in Ireland.
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?	MINIMAL	LOW	Refer to Question 2.06
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.	-	LOW	Potential impact relate primarily to the threat to native biodiversity. It would be expected that the costs incurred would be in relation to management (monitoring and control/eradication) of the species, research costs to determine potential impacts and interactions with native species and habitat, and increased resources for conservation action for native species.

Stage 2 - Detailed assessment: Section D – Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MODERATE	LOW	The most significant potential impact of tawny owls relates to biodiversity. Presence of the species in Ireland may result in displacement, reduction, or elimination of the native owl species.

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	MODERATE	MEDIUM	Entry is moderately likely via deliberate introduction or through natural colonisation. If the species were to enter Ireland the birds would most likely come from Britain and most like be as ornamental animals for perceived 'landscape improvement' or as holdings within private wildlife collections or by falconers. The species is highly adaptive. If introduced 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. Introductions are likely to take place in habitats suitable for survival, development and multiplication and tawny owls can occupy a wide variety of habitats, including open deciduous, mixed or coniferous forests, agricultural areas with trees, parks, cemeteries and large gardens (Diaz, 2011; Huntley *et al*., 2007; Peterson *et al*., 2004; Petty and Saurola, 1997).The species is likely to be introduced and/or encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000). Competition with other species or predation for natural enemies has not been reported to have significantly prevented tawny owl from becoming established in Britain, which in the event of introduction to Ireland is also likely to be the case. Forestry management practices (e.g. afforestation, reforestation and maturation of existing forestry) may aid species establishment on the island. Tawny owls occupy a variety of habitats and have the potential to establish over the majority of the Irish landscape. During an

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
				establishment phase (short-medium term) human assisted spread is likely to play a greater role in the dispersal of the species than natural spread. The most significant potential impact of tawny owls relates to biodiversity. Presence of the species in Ireland may result in displacement, reduction, or elimination of the native owl species. Because of the tawny owl's competitive dominance the potential establishment of this species in Ireland may negatively impact upon the Irish long-eared owl population. Because of the adaptive nature of the tawny owl, both in habitat and nesting requirements, the potential establishment of this species in Ireland may negatively impact upon the barn owl, possibly displacing it from traditional nesting sites in buildings (Voous and Cameron, 1988) and therein potentially reducing the breeding success of this Red Listed species.

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.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
6.01	What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	-	MEDIUM	There have been increases in the tawny owl's range and abundance in central Europe and decreases in the north (polar zone) and south (tropical zone) (Petty and Saurola, 1997). Climatic fluctuations may be involved, with the species showing a marked preference for a temperate climate (Figure 1). However, increases are most likely related to the maturation of forests (Petty and Saurola, 1997) and not climatic factors.
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	Based on geographic range climate change would not alter the risk assessment. 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.	-	MEDIUM	Modelling of the species potential rate of spread and likely distribution in Ireland would significantly strengthen the confidence in this risk assessment.

References

BALMER, D., GILLINGS, S., CAFFREY, B., SWANN, B., DOWNIE, I. & FULLER, R. 2013. *Bird Atlas 2007-11 The breeding and wintering birds of Britain and Ireland,* Thetfold, BTO Books.

BLI. 2012. *Strix aluco* [Online]. IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. . Available: www.iucnredlist.org [Accessed 8th March 2014].

BWI 2012. BirdWatch Ireland: Annual Report 2012. BirdWatch Ireland.

BWI. 2014a. *Barn Owls* [Online]. BirdWatch Ireland. Available: http://www.birdwatchireland.ie/IrelandsBirds/Owls/BarnOwl/tabid/1122/Default.aspx [Accessed 11th March 2014].

BWI. 2014b. *Birds of Conservation Concern In Ireland - BoCCI* [Online]. BirdWatch Ireland. Available: http://www.birdwatchireland.ie/Default.aspx?tabid=178 [Accessed 11th March 2014].

BWI. 2014c. *Long-eared Owl* [Online]. BirdWatch Ireland. Available: http://www.birdwatchireland.ie/IrelandsBirds/Owls/LongearedOwl/tabid/1123/Default.aspx [Accessed 11th March 2014].

BWI. 2014d. *Short-eared Owl* [Online]. BirdWatch Ireland. Available: http://www.birdwatchireland.ie/IrelandsBirds/Owls/ShortearedOwl/tabid/1124/Default.aspx [Accessed 11th March 2014].

BWI. 2014e. *Snowy Owl* [Online]. BirdWatch Ireland. Available: http://www.birdwatchireland.ie/IrelandsBirds/Owls/SnowyOwl/tabid/1125/Default.aspx [Accessed 11th March 2014].

COLHOUN, K. & CUMMINS, S. 2013. The Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds,* 9**,** 523-544.

CORINE 2006. Environmental Protection Agency, (2008); CORINE Landcover 2006 update (Ireland). Final Report.

DIAZ, K. 2011. *Strix aluco* [Online]. Animal Diversity Web. Available: http://animaldiversity.ummz.umich.edu/accounts/Strix_aluco/ [Accessed 11th March 2014].

FOSSITT, J. A. 2000. *A guide to habitats in Ireland*, Heritage Council/An Chomhairle Oidhreachta.

GALEOTTI, P. 1990. Territorial behaviour and habitat selection in an urban population of the tawny owl Strix aluco L. *Italian Journal of Zoology,* 57**,** 59-66.

GALEOTTI, P. & SACCHI, R. 2003. Differential parasitaemia in the tawny owl (Strix aluco): effects of colour morph and habitat. *Journal of Zoology,* 261**,** 91-99.

GLUE, D. & NILSSON, N. 1997. Asio otus: Long-eared Owl. *In:* HAGEMEIJER, W. J. M. & BLAIR, M. J. (eds.) *The EBCC Atlas of European Birds: Their distribution and abundance.* London: T & AD Poyser.

GOLLEY, M. 2004. *A Field Guide to the Birds of Britain and Ireland by Habitat,* UK, New Holland Publishers.

HOLLOWAY, S. 1996. *The historical atlas of breeding birds in Britain and Ireland 1875-1900,* London, T. & A.D. Poyser.

HUNTLEY, B., GREEN, R. E., COLLINGHAM, Y. C. & WILLIS, S. G. 2007. *A climatic atlas of European breeding birds,* Barcelona, Lynx Edicions.

JONES, E. 1979. Breeding of Short-eared Owl in South West Ireland. *Irish Birds,* 1**,** 377-380.

KEANE, T. & COLLINS, J. F. 2004. *Climate, weather and Irish agriculture, ,* Joint Working Group on Applied Agricultural Meteorology (AGMET), c/o Met Eireann, Dublin.

LEIGHTON, K., CHILVERS, D., CHARLES, A. & KELLY, A. 2008. Post-release survival of hand-reared tawny owls (Strix aluco) based on radio-tracking and leg-band return data. *Animal welfare,* 17**,** 207-214.

LEWIS, D. 2013. *Eurasian Tawny Owl - Strix aluco* [Online]. The Owl Pages. Available: http://www.owlpages.com/owls.php?genus=Strix&species=aluco. [Accessed 11th March 2014].

LUNDBERG, A. 1980. Why are the Ural Owl Strix uralensis and the Tawny Owl S. aluco parapatric in Scandinavia? *Ornis Scandinavica,* 11**,** 116-120.

LUSBY, J. 2012. Barn Owl Monitoring Programme; Raptor Conservation Project. Final Report 2012.

LUSBY, J., CREGG, P. & M., O. C. 2012. The West Offaly Raptor Conservation Project Final Report to Offaly Local Development Company.

O'CLERY, M., MCDONNELL, B. & LUSBY, J. 2012. The Duhallow Raptor Conservation Project; Final Report to IRD Duhallow.

PETERSON, R., MOUNTFORT, G. & HOLLOM, P. A. D. 2004. *Collins Field Guide: Birds - Britain and Europe,* London, Harper Collins Publisher.

PETTY, S. J. 1992. *Ecology of the Tawny Owl Strix aluco in the Sruce Forests of Northumberland and Argyll.* PhD, The Open University.
PETTY, S. J. & SAUROLA, P. 1997. Strix aluco: Tawnt Owl. *In:* HAGEMEIJER, W. J. & BLAIR, M. J. (eds.) *The EBCC atlas of European breeding birds: their distribution and abundance.* London: Poyser.
SCOTT, D. 1997. *The Long-eared Owl,* The Hawk and Owl Trust, London.
SHAWYER, C. R. 1998. *The Barn Owl,* Wheathampstead, Arlequin Press.
SNOW, D. W., PERRINS, C. M. & GILLMOR, R. 1998. *The birds of the Western Palearctic*, Oxford University Press Oxford.
SOUTHERN, H. N. 1970. The natural control of a population of tawny owls (Strix aluco). *Journal of zoology,* 162**,** 197-285.
SUNDE, P. 2005. Predators control post fledging mortality in tawny owls, Strix aluco. *Oikos,* 110**,** 461-472.
TAYLOR, I. R. 1994. *Barn Owls: Predator – Prey Relationships and Conservation,* Cambridge, Cambridge University Press.
VOOUS, K. H. & CAMERON, A. 1988. *Owls of the northern hemisphere,* London, Collins.
WOT. 2005. *Tawny Owl: Strix aluco* [Online]. World Owl Trust. Available: http://www.owls.org/Species/strix/tawny_owl.htm [Accessed 11th March 2014].