Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain.

Risk analysis comprises three component parts: risk assessment, risk management and risk communication. This document relates to risk assessment only.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Drafted by an independent expert on the species.
- Peer reviewed by a different expert on the same species.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Considered and approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

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

Common misconceptions about risk assessments

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

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are advisory and therefore are part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. They are an assessment based on the evidence available at that time. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available.

Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

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

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism:	***Bubo bubo* - Eurasian Eagle Owl**	
	Objectives:	Assess the risks associated with this species in GB	
	Version:	FINAL 05/10/2010. Original draft 10/11/09.	
N	**QUESTION**	**RESPONSE**	**COMMENT**
1	What is the reason for performing the Risk Assessment?		Request by the GB Programme Board for Non-native Species
2	What is the Risk Assessment area?	Great Britain	
3	Does a relevant earlier Risk Assessment exist?	NO OR UNKNOWN (Go to 5)	
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?		
	Stage 2: Organism Risk Assessment **SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Bubo bubo* - Eurasian Eagle Owl. Although numerous subspecies have been described, a recent review examining phylogenetic relationships within the genus *Bubo* recognises 14 subspecies, one of which is thought to be a separate species (Wink & Heidrich 1999). The subspecies *Bubo bubo bubo* occurs in the United Kingdom.
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	YES (Go to 9)	The Eurasian Eagle Owl is a known predator of a range of bird and mammal species and is known to be intolerant of other raptors and owls nesting within its territory (Cramp *et al.* 1985). Productivity of other raptor species has been shown to be deterimentally affected by the presence of breeding Eagle Owls (Brambilla *et al*. 2006, Sergio *et al. 2007)*. The species may, on occasion, be aggressive towards people within the breeding territory (Blondel & Badan, 1976).
8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?		
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	The Eurasian Eagle Owl was first documented breeding in the UK in 1984 and has been reported breeding in 13 of the last 23 years (Holling *et al*. 2007). The species has been reported breeding annually since 1997, with a maximum of three pairs in any single year over this period (Holling *et al*. 2007).
10	Is the organism widely distributed in the Risk Assessment area?	NO (Go to 11)	The available evidence suggests that, as a breeding species, the Eurasian Eagle Owl is maintaining a small presence in at least northern and central England and, possibly, southern Scotland. However, records of single birds (including known aviary escapes) have been reported from other parts of the UK, with territorial behaviour or attempted breeding reported from a number of localities (Holling *et al*. 2007). Melling et al. (2008) also report successful breeding in southern England as does Toms (2009), with three young raised at a site in southern England in 2005.
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?	YES (Go to 12)	The species is known to occupy a range of habitats for breeding, using woodland, mixed agricultural landscapes and even urban habitats within the western European component of its known range (Cramp *et al.* 1985). Similar habitats exist within the UK. Eagle Owls may forage at some distance from the nest site and so may not require both feeding and nesting habitats to be present within the same locality (Dalbeck *et al*. 1998, Martinez *et al*. 2003). As a versatile and opportunistic species, taking mammalian prey (typically ranging in size from Field Vole *Microtus agrestis* to adult hares *Lepus*) and avian prey (typically ranging in size from Jay *Garrulus glandarius* to adult Mallard *Anas platyrhynchos*), suitable prey spectrums exist within the UK (Cramp *et al.* 1985, Donázar *et al*. 1989). Of particular importance may be populations of Rabbit *Oryctolagus cunniculus*, a favoured prey species within other parts of its European range.
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?	NO (Go to 14)	
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		
14	Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment area or sufficiently similar for the organism to survive and thrive?	YES (Go to 16)	Breeding populations exist within other European countries, the species occupying similar ecoclimatic zones to those available within the UK Risk Assessment area (Martinez *et al*. 2003, Penteriani *et al*. 2001).

15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?	NO (Go to 20)	
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?	YES (Go to 17)	The status of the Eagle Owl within the UK has been the subject of some discussion, with suggestions that it is native to the area because of the presence of pre-medieval archaeological records (Dennis 2005), though with no supporting evidence presented. However, a recent review of the fossil and archaeological evidence suggests that the species was present in the UK during the early Holocene (alongside woodland and a temperate climate). On this basis, the author (Stewart 2007) believes the species to be part of the natural, native British fauna. No evidence was found of the species establishing viable populations outside of its original (though not necessarily current) range. Melling *et al.* (2008) indicate that there is some evidence a small population of Eagle Owls were present in GB around 10,000 years ago (as a result of slow recolonisation following the glacial retreat), but may have died out when the land bridge to mainland Europe was lost and did not subsequently naturally colonise Great Britain. The BOU classifies Eagle Owl as non-native (Dudley *et al.* 2006).
17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	Although this is a territorial and largely sedentary species, with a relatively low reproductive output and low dispersal rates (Olsson 1997), deliberate introductions or aviary escapes could lead to the establishment of pairs in new areas. While the available evidence from ringing and tracking studies suggests that the species is largely sedentary and unwilling to cross large expanses of water (c.f. Melling *et al* . 2008), dispersing youngsters may undertake significant movements, as revealed by the recovery data from two-British ringed youngsters (moving 160km and 218km respectively) and from satellite tracking work carried out in Switzerland (Aebischer *et al.* 2007). Even so, it is felt that natural vagrancy to Britain from neighbouring countries is extremely unlikely.
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?	YES OR UNCERTAIN (Go to 19)	The species is a known predator of a wide range of birds and mammals, including a number of species of conservation concern (*e.g.* Pine Marten *Martes martes* , Capercaillie *Tetra urogallus* and various raptors and owls) and will not tolerate other breeding raptors or owls within its breeding territory (Busche *et al.* 2004). The species has been known to take livestock (lambs), although this appears to be a rare occurrence (Cramp *et al* . 1985). The remains of a first-year female Hen Harrier found near the nest were assumed to be the result of Eagle Owl predation, but not sure if this was deemed conclusive evidence of predation. More recent evidence has been recorded, for example the 2010 incident in Bowland, which was caught on film.
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B	
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.		

B	SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences			
	Probability of Entry	**RESPONSE**	**UNCERTAINT**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	few - 1	MEDIUM -1	Further spread could arise 1) from accidental escapes from aviaries, 2) from the deliberate release of birds by those keen to see the species re-established within the UK, 3) from dispersal of young from successful breeding attempts within the Risk Assessment area and 4) from the arrival of birds dispersing from breeding populations in other European countries.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.			1) Escape of birds from captivity.
1.3	How likely is the organism to be associated with the pathway at origin?	very likely - 4	MEDIUM -1	Melling *et al.* (2008), examining the Independent Bird Register (IBR) for the period 1994-2007, provide a minimum estimate of 3,000 Eagle Owls (inlcuding *B.b. bengalensis*) in captivity in Great Britain, which includes the 440 birds registered with the IBR. The same authors note that, in the 10-year period to June 2007, Defra issued 3,370 CITES Article 10 certificates for Eagle Owls held in Britain. The IBR figures did not include B.b. bengalensis as this is counted as a separate species on the Register.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	unlikely - 1	HIGH -2	There are no published figures detailing the number of individual bird keepers who have multiple Eagle Owls within their collections.
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	MEDIUM -1	The longevity of the species within captivity can be in excess of 60 years (Nigrelli, 1954). According to the EURING databank the oldest wild-living Eagle Owl was found dead at the age of at least 26 years and 7 months (this was a Finnish bird).
1.6	How likely is the organism to survive or remain undetected by existing measures?	moderately likely - 2	LOW - 0	As there is no formal requirement to register captive Eagle Owls, it is likely that many escapes will go unreported and, hence, undetected by existing measures. Also eagle owls are largely nocturnal, reducing further the likelihood of detection.
1.7	How likely is the organism to survive during transport /storage?	N/A		
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	N/A		
1.9	What is the volume of movement along the pathway?	minor - 1	HIGH -2	Since the IBR was established in 1994, the figure of 440 registered birds used by Melling *et al.* (2008) could imply a figure of 33 new registrations per year.
1.10	How frequent is movement along the pathway?	occasionally - 2	HIGH -2	see above (1.9)
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	very widely - 4	MEDIUM -1	The species is likely to be well represented throughout the Risk Assement Area. Toms (2009) shows the distribution of Eagle Owl records published in county bird reports over the period 1984-2006. This shows the species to be widely distributed within the Risk Assessment area.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	likely - 3	MEDIUM -1	1.12 - The flying of Eagle Owls for falconry could aid establishment (Eagle Owls are flown throughout the year, but less so during the summer months as this is the moult period).
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	likely - 3	MEDIUM -1	Eagle Owls flown for falconry are more likely to escape from captivity than those held purely for display within aviaries. The high percentage of registered birds escaping would support the view that birds used for falconry (and more likely to be voluntarily registered) are more likely to escape.
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	likely - 3	MEDIUM -1	Using figures provided by the IBR, Melling *at al.* (2008) calculated that 123 registered birds escaped from captivity over the period 1994-2007, which represents 28% of the registered captive population. Extrapolation of these figures to the estimated minimum captive population (3,000 birds) would suggested a figure of 840 escapees, or 65 per year.

	Probability of Establishment	RESPONSE	UNCERTAINT	COMMENT
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	very similar - 4	LOW - 0	Eurasian Eagle Owls are already established within the Risk Assessment area and the habitats/climatic conditions available more widely within this area are similar to those seen elsewhere within the known range of this species (Martinez *et al*. 2003).
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	similar - 3	MEDIUM -1	Types and levels of pollution that may act against the spread of the species, through effects on breeding performance and mortality, are likely to be similar to those seen elsewhere within the western European range (Martinez *et al*. 2003). Adults in Germany die mainly from collision with electric power lines (Augst 2003), a pattern that may well be repeated in the Risk Assessment area as evidenced by the single recovery of a British-ringed Eagle Owl, found dead below power cables (Clark *et al.* 2007). Other mortality causes that may influence spread within the Risk Assessment area are collision with road/rail traffic and drowning (Ristig *et al.* 2003). Illegal persecution may also affect establishment.
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	very many - 4	LOW - 0	Eurasian Eagle Owls have been recorded taking a wide range of vertebrate and invertebrate prey. For example, 34 of the wild mammalian prey species listed by Cramp *et al.* (1985) as being taken by Eagle Owl are to be found within the Risk Assessment area. Rabbit *Oryctolagus cunniculus* has the potential to be an important prey item within the Risk Assessment Area. One additional mammalian prey species, Grey Squirrel *Sciurus carolinensis,* is not listed by Cramp *et al.* but may be exploited within the Risk Assessment area. Prey availability has been shown to influence the breeding performance of this species in its native range (Pentriani *et al*. 2002, Dalbeck & Heg 2006), influencing whether or not breeding is attempted and, to a lesser extent, productivity of individual nesting attempts (Olsson 1997). The species has shown itself to be adaptable in terms of the habitats used for breeding, exploiting forests, heathland, agricultural landscapes, rocky terrain and even urban areas (Cramp *et al.* 1985).
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	widespread - 4	LOW - 0	There is an excellent understanding of the scale and distribution of populations of avian prey species (Gibbons *et al.* 1993, Baker *et al*. 2006) and, to a lesser extent, mammalian prey species (Battersby 2005) within the Risk Assessment area. Existing habitat datasets (e.g. CS2000, Fuller *et al.* 2002) are available and could be used to establish the availability of suitable habitats for the species within the Risk Assessment area. Although the species has shown the ability to utilise a diverse range of habitats, there is some evidence to suggest that nesting sites may be the limiting factor in Central European populations (compared with Mediterranean populations); this may limit development of the population within south and eastern parts of the Risk Assessment area (Dalbeck & Heg 2006).
1.19	If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	N/A	LOW - 0	The Eurasian Eagle Owl does not require another species for establishment.
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	very likely - 4	LOW - 0	Competition for nest sites with other bird species does not occur in Eagle Owls because it is the dominant prevailing species (Brauneis, 2003).
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	very likely - 4	LOW - 0	Only White-tailed Eagle *Haliaeetus albicilla* and Golden Eagle *Aquila chrysaetos* are known to kill Eagle Owls and even then there are just a handful of documented records (Mikkola 1983). This suggests that the presence of these two species within the Risk Assessment area will not prevent further establishment. Badger *Meles meles*, Pine Marten *Martes martes* and Red Fox *Vulpes vulpes* might predate Eagle Owl nests within the Risk Assessement Area, but it is unclear from the published literature if the level of such predation would be sufficient to curtail establishment - the species is effectively already established here.
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	unlikely - 1	MEDIUM -1	Persecution and disturbance have been shown to influence nest site selection, breeding performance and territory stability in Spain (Martinez *et al.* 2003, Ortego 2007). Levels of persecution may be similar within the risk assessment area to those seen in other parts of the western European range. Instances of disturbance and persecution have already been noted at breeding sites within the Risk Assessment area (Holling *et al*. 2007), with birds deliberately shot and there is also the potential for deliberate poisoning of birds. There are differences in the amount of "low disturbance" habitat within the Risk Assessment area compared with that present in other parts of the current range. This may influence the likelihood and speed of establishment but may not be as influential as wider food availability.
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	very likely - 4	LOW - 0	There are no existing control or husbandry measures in place to prevent further establishment of this species. Although adding this species to Schedule 9 to the Wildlife and Countryside Act 1981 may help limit escapes into the wild.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	frequent - 3	MEDIUM -1	The species is commonly kept in captivity for the purposes of falconry. Over 2,000 licences to keep pet eagle owls were applied for between 1998 and 2003 (Anon 2007).

1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	likely - 3	LOW - 0	Eurasian Eagle Owls may live to more than 60 years of age in captivity, with wild birds more likely to reach a maximum of 20. According to the EURING databank the oldest wild-living Eagle Owl was found dead at the age of at least 26 years and 7 months (this was a Finnish bird). Young birds usually start breeding at 2-3 years of age (König et al.1999). While a 27 year-study of Eagle Owl breeding ecology in France revealed a mean of around 1.7 young per breeding pair per year (Pentriani et al. 2004), a 65 year study in Germany showed an average of 0.43 young per pair (Augst 2003).
1.26	How likely is it that the organism's capacity to spread will aid establishment?	moderately likely - 2	MEDIUM -1	The deliberate release or escape of captive bred Eagle Owls may aid establishment of the species within the Risk Assessment area. Known aviary escapes have been recorded breeding within the Risk Assessment area (Holling *et al*. 2007). Although strongly territorial and largely sedentary, young birds may disperse some distance from their natal sites (Ristig *et al*. 2003), as also noted by the single recovery of a British-ringed Eagle Owl; this young bird was recovered 218km from its natal site, covering the distance in 11 months (Clark *et al*. 2007). Aebischer et al. (2007) note that, for the population studied, there is the potential for long-distance dispersal of birds and that the distances involved are sufficient to parallel a movement from continental Europe to Britain. However, as noted in Toms (2009) there is a suggestion from ring-recovery data that these birds are reluctant to cross large expanses of water. At the time of carrying out the Risk Assessment, a literature review did not reveal any papers that supported movements into Britain from the Continent. Kelly et al (2010), does provide evidence which might suggest such a movement. However, there is some uncertainty in the Kelly paper, the authors stating that they cannot rule out that the bird hatched in the wild in the UK in a region (most likely Scotland), with a low stable isotope value for hydrogen before moving to Norfolk.
1.27	How adaptable is the organism?	adaptable - 3	LOW - 0	The species is adaptable, as demonstrated by the wide range of habitats and climatic conditions used, by the wide range of nest sites selected and by the diversity of prey species taken (Cramp *et al*. 1985).
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	unlikely - 1	MEDIUM -1	A study of the DNA sequences of 20 Eagle Owls from western and central Europe revealed a strong heterogeneity, indicating that birds from various origins and subspecies had been multiplied and released in the breeding programmes from which most of these birds would have originated (many would have been descendents of birds released as part of the German reintroduction project) (Wink & Hendrich 1999).
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	few - 1	HIGH -2	It is difficult to answer this question because of resolving what constitutes the original range of this species. Certainly, the species has been able to enter and establish itself within the Risk Assessment area. The Eagle Owl recolonization of Denmark (after an absence of 100 years) was a direct result of the reintroduction programme taking place in northern Germany (Frikke & Tofft 1997). Many of the populations within western Europe result from reintroduction or reinforcement programmes (Zuberogoitia *et al.* 2003, Dalbeck & Heg 2006).
1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	unlikely - 1	MEDIUM -1	The sedentary nature and territoriality of breeding pairs, together with the nature of the territorial behaviour (calling from song posts) should allow control of the organism at a stage when its population is at a low level. For this strategy to work, it would be essential to gain support from the birdwatching community and get them to report the presence of territorial birds.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	moderately likely - 2	MEDIUM -1	The recovery of breeding populations in the Netherlands, northern Germany and Scandinavia would suggest that the likelihood of young birds reaching the Risk Assessment area through natal dispersal has increased. It is likely that the number of individuals which may escape or be deliberately released from captivity is likely to continue at a similar level to that currently occurring. Both of these processes may lead to the establishment of transient populations, however the reluctance of the species to cross large expanses of water may make arrival from neighbouring countries through natural vagrancy unlikely.

	Spread	RESPONSE	UNCERTAINT	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	slow - 1	MEDIUM -1	The low annual reproductive rate and low starting population is likely to mean that the rate of spread is low, especially during the early part of the establishment phase.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	slow - 1	HIGH -2	Spread associated with human assistance, especially deliberate and targeted releases (supported by certain organisations - Warburton 2008) could lead to moderate spread of the species within the Risk Assessment area. Examination of data from the reintroduction programme carried out in northern Germany, suggests that a significant number of young birds would need to be released to establish the species more widely within the Risk Assessment area (Asmussen 2003).
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	with some difficulty - 2	MEDIUM -1	Containment is likely to be effective only through a programme of controlled culling. Even with this, there is the likelihood of continued escapes and deliberate releases, with the potential for individuals from these to disperse beyond the Risk Assessment area.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.		MEDIUM -1	The entire Risk Assessment area but with establishment and spread are most likely to occur in north and central England and southern Scotland, where the species has already been recorded breeding or indulged in territorial behaviour.

	Impacts	RESPONSE	UNCERTAINT	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	minimal - 0	LOW - 0	Within its current range the species has not been reported to cause any significant economic losses.
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	minimal - 0	LOW - 0	The direct negative economic effect of this species, either current or future, within the Risk Assessment area is thought to be minimal. This assessment is based on the known situation elsewhere within its current range.
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minimal - 0	LOW - 0	It is thought that any loss in producer profits is likely to be minimal. Again this is based on what is known of the situation elsewhere within its current range.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	No reduction in consumer demand is predicted.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	very unlikely - 0	LOW - 0	No losses to export markets are predicted.
2.10	How important would other economic costs resulting from introduction be? (specify)	moderate - 2	LOW - 0	Given the known impacts of this species on other birds of prey, monitoring is likely to be required to properly assess the changing nature of the threat, should populations continue to establish and spread (Underwood 1995, Sergio *et al.* 2007*)* . The species is not monitored effectively by current cross-species schemes and is likely to require special targeted monitoring (including ringing, detailed nest recording and surveys to monitor impact on other raptor species).
2.11	How important is environmental harm caused by the organism within its existing geographic range?	major - 3	LOW - 0	The establishment of Eagle Owls in northern Germany during the 1980s resulted in a significant decline on Goshawk *Accipiter gentilis* density, with the owls taking over pre-existing Goshawk territories. No Goshawks were able to breed within 500m of an Eagle Owl nest and beyond this distance were only able to breed successfully during a period when Eagle Owl densities were themselves low (Busche *at al.* 2004). Evidence for potential effects on other species is mixed. Asmussen (2003), working in Germany, concluded that the Eagle Owl has little or no deterimental effect on populations of White-tailed Eagle *Haliaeetus albicilla* , Peregrine *Falco peregrinus* , Raven *Corvus corax* or Common Buzzard *Buteo buteo* . Brambilla *et al* . (2006), working in northern Italy found that proximity to Eagle Owl nests lowered the productivity of cliff-nesting Peregrines *Falco peregrinus* . Underwood (1995) noted the sudden disappearance of nesting Goshawk, Peregrine, Sparrowhawk *Accipiter nisus* and Merlin *Falco columbarius* in Derbyshire. Sergio *et al.* (2007) working in the Alps, found that Tawny Owl breeding output declined in proximity to Eagle Owl nests. A number of species of conservation interest, additional to the owl and raptor species mentioned, also feature in Eagle Owl diet within its current range. These include Pine Marten *Martes martes* , Capercaillie *Tetrao urogallus* , Curlew *Numenius arquata* and Red Grouse *Lagopus lagopus* - the latter two documented as prey here in the Risk Assessment area (Underwood 1995).
2.12	How important is environmental harm likely to be in the Risk Assessment area?	major - 3	LOW - 0	The effects seen within the existing geographical range are likely to be similar here within the Risk Assessment area. As noted above, the disappearance of breeding raptors from the vicinity of nests and actual predation of species of conservation concern have already been documented within the Risk Assessment area (Underwood 1995). In terms of potential impacts one can look at a number of species. For example, 10% of the Scottish Hen Harrier *Circus cyaneus* population, is associated with scrub/brash and mature conifer plantations (Sim *et al.* 2007) - the latter being a habitat that is being increasingly used by the species - and this component of the population may be at risk from Eagle Owls should they become established across the Hen Harrier range. Suspected Hen Harrier predation by Eagle Owls in North West England in 2007 and film footage of Eagles Owls attacking a sitting Hen Harrier was recorded in June 2010 at Bowland.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	minor - 1	MEDIUM -1	Direct social harm is likely to be minimal but the knock of effects of losing high profile species of conservation and wider publilc interest may mean that social harm is more important than first apparent. However, there are social benefits associated with the presence of the species; note the publicity associated with the breeding attempt in Lancashire in 2007 and the number of birdwatchers who visited the site. It has been suggested that the species should be reintroduced for the purpose of social benefit (see Nevard & Penfold 1978).
2.14	How important is the social harm likely to be in the Risk Assessment area?	minor - 1	MEDIUM -1	See 2.13 above.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	unlikely - 1	LOW - 0	No genetically similar native species exist. However, there is likely to be a degree of genetic variability within the captive population (deriving from birds of different subspecies) and this may modify the genetic nature of any Eagle Owls of true wild *B.b. bubo* origin present within the Risk Assessment area or in neighbouring areas.

2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no affect on populations of the organism if introduced?	very likely - 4	LOW - 0	Only White-tailed Eagle *Haliaeetus albicilla* and Golden Eagle *Aquila chrysaetos* are known to kill Eagle Owls and even then there are just a handful of documented records (Mikkola 1983). This suggests that the presence of these two species within the Risk Assessment area will not have any influence on the organism.
2.17	How easily can the organism be controlled?	easily - 1	LOW - 0	The sedentary nature and territoriality of breeding pairs, together with the nature of the territorial behaviour (calling from song posts) should allow control of the organism at a stage when its population is at a low level. For this strategy to work, it would be essential to gain support from the birdwatching community and get them to report the presence of territorial birds. Control will need to be sustained, allowing for the fact that continued releases and accidental escapes are likely to continue over time.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	unlikely - 1	MEDIUM -1	Although control measures are unlikely to disrupt systems for the control of other species, they may do so if available resources are limiting.
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	unlikely - 1	HIGH -2	There is little published information on the parasites and diseases associated with this species from which to make a judgment on the scale of the effect. 1. Newcastle Disease virus antibodies were detected in 5 (out of 5) Eagle Owls tested as part of a wider study carried out in Switzerland in the late 1990s. The study (Schelling *et al*. 1999) was carried out in response to an outbreak of the disease in commercial chicken flocks. The authors concluded that contact with wild birds was significantly less important in the spread of the disease than other routes of possible transmission. 2. *Salmonella enterica* has been reported from Eagle Owl in Turkey (Kocabiyik *et al*. (2006), the pathogen being a well-known cause of Salmonellosis in a wide range of wild birds. 3. Antibodies to *Chlamydia psittaci* (which causes chlamydiosis) were found in one of four Eagle Owls sampled in Germany (Schettler *et al*. 2001). The disease is thought to be almost ubiquitous in free-living birds of prey in the area (Gerbermann & Korbel 1993). 4. The blood parasite *Leucocytozoon ziemanni* has been identified in Eagle Owls in Spain and has been reported from other non-GB owl species (Ortego & Espada 2007). *Leucocytozoon* spp. are spread by black flies *Simulium* spp. 5. *Herpesvirus strigis* is a pathogen of several species of owl, including *Bubo bubo* (Burtscher & Sibalin 1975). 6.*Trichomonas gallinae* has been reported in Eagle Owl in Germany (Rautenschlein & Legler 2006) - this disease has been reported in a range of bird species within Great Britain, most notably the outbreak in Greenfinches since 2006.
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur		LOW - 0	Based on the current pattern of breeding records, at least 17 pairs breeding (1984-2007), environmental impacts are likely to be most pronounced in north England, central England and southern Scotland over the short term. These areas (plus potentially northern Scotland and Wales) may see the most significant environmental impacts longer term if the population increases significantly, because these are important areas for those other breeding species likely to suffer from predation or a decreased productivity.

Summarise Entry	likely - 3	MEDIUM -1	The Eurasian Eagle Owl is already established as a breeding species (1-3 pairs annually) within the Risk Assessment area. Further expansion is most likely to occur through 1) escapes and releases of captive birds, 2) dispersal of young from breeding attempts made in the wild. It is also possible, though less likely, that individuals from populations elsewhere in Europe may reach the Risk Assessment area through natal dispersal as populations there increase.
Summarise Establishment	likely - 3	MEDIUM -1	The species is already established and further establishment within other parts of the Risk Assessment area may be likely because of suitable ecoclimatic conditions and prey availability.
Summarise Spread	slow - 1	MEDIUM -1	Spread from successful breeding attempts is likely to be low during the short term but may increase in numbers build up within existing areas. There is the potential for rapid spread into new parts of the Risk Assessment area through deliberate or accidental release. It has already been established that escaped birds may go on to breed in the wild (Hollings *et al.* 2007).
Summarise Impacts	moderate - 2	MEDIUM -1	The most significant impacts will be environmental, with native raptor and owl species most likely to suffer through direct predation and competition (Hen Harrier is a particular concern). Other native species of conservation importance, such as Curlew, Pine Marten, Red Squirrel *Scuirus vulgaris* and Capercaillie, may also suffer from predation.
For pathway/policy risk assessment Assess the potential for establishment and economic/environmental/social impacts of another organism or stop			
Conclusion of the risk assessment	MEDIUM -1	MEDIUM -1	The Risk Assessment area already has an established (though small) population of Eurasian Eagle Owls, first noted breeding in 1984. The growth of this population has been slow, but with a long-lived species like this the establishment phase may be slow initially but then speed up. The potential impact of an increased population on native raptor and owl species, plus a number of other important species, is thought to be significant. Containment/control is an option and is likely to be most effective if carried out during the early part of the establishment phase. However, there is an element of public support for the species and its status as a native/non-native has yet to be completely resolved despite the BOU classifying this species as non-native (Dudley *et al.* 2006).
Conclusions on Uncertainty		MEDIUM -1	This risk assessment is based on scientific literature relating to existing populations of Eurasian Eagle Owls both in their native range and here within the Risk Assessment area. There is little uncertainty about their use of ecoclimatic zones within the current range, the range of prey species taken or the effects of competition with a number of the raptor/owl species present within the Risk Assessment area. However, there is a degree of uncertainty about the origins of those birds already present in the area, about the genetic implications of establishment for neighbouring populations and about the status of the species as a native/non-native despite the BOU classifying this species non-native (Dudley *et al.* 2006).

References

Aebischer, A., Koch, S., Nyffler, P. & Ariettaz, R. (2007). Juvenile dispersal and mortality factors in Eagle Owls (*Bubo bubo*) assessed by satellite telemetry - toward targeted conservation measures. Paper presented to World Owl Conference 2007, 31st October-4th November, Groningen, The Netherlands.

Anon (2007). RSPB policy statement on Eagle Owls. Published online at http://www.rspb.org.uk/ourwork/policy/species/eagleowls.asp. Page visited 14.02.2008.

Asmussen, R. (2003). Die Wiedereinbürgerung des Uhus *Bubo bubo* in Schleswig-Holstein. *Vogelwelt* **124**: 223-228.

Augst, U. (2003). Reproduktion und Bestandsentwicklung des Uhus *Bubo bubo* im Elbsandsteinebirge. *Vogelwelt* **124**: 229-239.

Baker, H., Stroud, D.A., Aebischer, N.J., Cranswick, P.A., Gregory, R.D., McSorley, C.A., Noble, D.G. & Rehfisch, M.M. (2006). Population estimates of birds in Great Britain and the United Kingdom. *British Birds* **99:** 25-44.

Battersby, J. (2005). UK Mammals: species status and population trends. JNCC/Tracking Mammals Partnership, Peterborough.

Blondel, J. & Badan, O. (1976). La biologie du Hibou grand-duc en Provence. *Nos Oiseaux* **33**: 189-219.

Brambilla, M., Rubolini, D. & Guidali, F. (2006). Eagle Owl *Bubo bubo* proximity can lower productivity of cliff-nesting Peregrines *Falco peregrinus*. *Ornis Fennica* **83**: 20-26.

Brauneis, W. (2003). The Eagle Owl *Bubo bubo* in Hesse, Germany: its return and population trend. *Vogelwelt* **124**: 241-247.

Burtscher, H. & Sibalin, M. (1975) *Herpesvirus strigis*: host spectrum and distribution in infected owls. *Journal of Wildlife Diseases* **11**: 164-169.

von Busche, G., Raddatz, H.-J. & Kostrzewa, A. (2004). Nistplatz-Konkurrenz und Prädation zwischen Uhu (*Bubo bubo*) and Habicht (*Accipiter gentilis*): erste Ergebnisse aus Norddeutschland. *Die Vogelwarte* **42**: 169-177.

Clark, J.A., Robinson, R.A., Adams, S.Y., Grantham, M.J., Risely, K., Balmer, D.E., Blackburn, J.R., Griffin, B.M., Marchant, J.H. & Kimmel, V. (2007). Bird ringing in Britain and Ireland in 2005. *Ringing & Migration* **23** (3): 156-192.

Cramp, S., Books, D.J., Dunn, E., Gillmor, R., Hollom, P.A.D., Hudson, R., Nicholson, E.M., Ogilvie, M.A., Olney, P.J.S., Roselaar, C.S., Simmons, K.E.L., Voous, K.H., Wallace, D.I.M., Wattel, J. & Wilson, M.G. (1985). Handbook of the Birds of Europe, the Middle East and North Africa. Volume IV: Terns to Woodpeckers, Oxford University Press, Oxford.

Dalbeck, L., Bergerhausen, W. & Krishner, O. (1998). Telemetriestudie zur Orts- und Partnertreue beim Uhu *Bubo bubo*. *Vogelwelt* **119**: 37-344.

Dalbeck, L. & Heg, D. (2006). Reproductive success of a reintroduced population of Eagle Owls *Bubo bubo* in relation to habitat characteristics in the Eifel, Germany. *Ardea* **94** (1): 3-21.

Dennis, R. (2005). The eagle owl has landed. BBC Wildlife 23 (13): 24-29.

Donázar, J.A., Hiraldo, F., Delibes, M. & Estrella, R.R. (1989). Comparative food habits of the Eagle Owl *Bubo bubo* and the Great Horned Owl *Bubo virginianus* in six Palearctic and Nearctic biomes. *Ornis Scandinavica* **20**: 298-306.

Dudley, S.P., Gee, M., Kehoe, C., Melling, T.M. & the BOURC. (2006) The British List: A Checklist of Birds of Britain (7th Edition). Ibis 148: 526-563.

Frikke, J. & Tofft, J. (1997). Den store Hornugles *Bubo bubo* genindvandring til Danmark med særligt henblik på Sønderjylland. *Dansk Ornithologisk Forenings Tidsskrifnsk* **91**: 63-68.

Fuller, R.M., Smith, G.M., Sanderson, J.M., Hill, R.A. & Thompson, A.G. (2002). Land Cover Map 2000: a general description of the UK's new vector GIS based on classification of remotely sensed data. *Cartographic Journal* **39**: 15-25.

Gerbermann, H. & Korbel, R. (1993). Zum Vorkommen von *Chlamydia psittaci* infektionen bei Greifvogeln as freier Wildbahn. *Tierarztliche Praxis* **21**: 217-224.

Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) *The new atlas of breeding birds in Britain and Ireland: 1988-1991*. T. & A.D. Poyser

Holling, M. & The Rare Birds Breeding Panel. (2007). Non-native breeding birds in the United Kingdom in 2003, 2004 and 2005. British Birds 100: 638-649

Kelly, A. Leighton, K. and Newton, J. (2010). Using stable isotopes to investigate the provenance of a Eurasian Eagle Owl (Bubo bubo) found in Norfolk, England. British Birds, 103: 213-222.

Kocabyik, A.L., Cangul, I.T., Alasonyalilar, A., Dedicova, D. & Karpiskova, R. (2006). Isolation of *Samonella* Enteritidis Phage Type 21b from a Eurasian Eagle-owl (*Bubo bubo*). *Journal of Wildlife Disease* **42** (3): 696-698.

König, C., Weick, F. & Becking, J.H. (1999). *Owls: a guide to owls of the world*. Pica Press, Robertsbridge.

Martinez, J.A., Serrano, D. & Zuberogoitia, I. (2003). Predictive models of habitat preferences for the Eurasian Eagle Owl *Bubo bubo*: a multiscale approach. *Ecography* **26**: 21-28.

Melling, T, Dudley, S. Doherty, P. (2008). The Eagle Owl in Britain. *British Birds* **101** (9): 478-490.

Mikkola, H. (1983). *Owls of Europe*. T & A D Poyser, Waterhouses.

Nevard, T.D. & Penfold, J.B. (1978). Wildlife conservation in Britain: the unsatisfied demand. *Biological Conservation* **14**: 25-44.

Nigrelli, R.F. (1954). Some longevity records of vertebrates. *Transactions of the New York Academy of Science* **16**: 296-299.

Olsson, V. (1997). Breeding success, dispersal and long-term changes in a population of Eagle Owls *Bubo bubo* in southeastern Sweden 1952-1996. *Ornis Svecica* **7**: 49-60.

Ortego, J. (2007). Consequences of Eagle Owl nest-site habitat preference for breeding performance and territory stability. *Ornis Fennica* **84**: 78-90.

Ortego, J. & Espada, F. (2007) Ecological factors influencing disease risk in Eagle Owls *Bubo bubo*. *Ibis* **149**: 386-395.

Penteriani, V., Gallardo, M., Roche, P. & Cazassus, H. (2001). Effects of landscape spatial structure and composition on the settlement of the Eagle Owl *Bubo bubo* in a Mediterranean habitat. *Ardea* **89** (2): 331-340.

Pentriani, V., Gallardo, M. & Roche, P. (2002). Landscape structure and food supply affect Eagle Owl (*Bubo bubo*) density and breeding performance: a case of intra-population heterogeneity. *Journal of Zoology, London* **57**: 365-372.

Pentriani, V., Delgado, M.D.M., Gallardo, M. & Ferrer, M. (2004). Spatial heterogeneity and structure of bird populations: a case example with the Eagle Owl. *Population Ecology* **46**: 185-192.

Rautenschlein, S. & Legler, M. (2006). Eulenherpesvirusinfektion (*Hepatosplenitis infectiosa strigum*) mit zusatzlich bestehender Trichomonadose (*Trichomonas gallinae*) und Aspergillose (*Aspergillus fumigatus*) bei einem Uhu (*Bubo bubo*) aus Volierenhalttung. *Praktische tierzat* **87** (9): 688-694.

Ristig, U., Wadewitz, M. & Zang, H. (2003). Der Uhu *Bubo bubo* im nördlichen Harzvorland. *Vogewelt* **124**: 249-253.

Schelling, E., Thur, B., Griot, C. & Audige, L. (1999). Epidemiological study of Newcastle Disease in backyard poultry and wild bird populations in Switzerland. *Avian Pathology* **28**: 263-272.

Schettler, E., Langgemach, T., Sommer, P., Streich, J. & Frolich, K. (2001). Seroepizoology of selected infectious disease agents in free-living birds of prey in Germany. *Journal of Wildlife Disease* **37** (1): 145-152.

Sergio, F., Marchesi, L., Pedrini, P. & Penteriani, V. (2007). Coexistence of a generalist owl with its intraguild predator: distance-sensitive or habitat-mediated avoidance? *Animal Behaviour* **74**: 1,607-1616.

Sim, I.M.W, Dillon, I.A., Eaton, M.A., Etheridge, E., Lindley, P., Riley, H., Saunders, R., Sharpe, C. & Tickner, M. (2007). Status of the Hen Harrier *Circus cyaneus* in the UK and Isle of Man in 2004, and a comparison with the 1988/89 and 1998 surveys. Bird Study 54: 256-267.

Stewart, J.R. (2007). The fossil and archaeological record of the Eagle Owl in Britain. British Birds 110 (8): 481-486.

Toms, M. 2009. Eagle Owls in Britain: origins and conservation implications. Br. Wildlife 20: 405–412.

Underwood, W. (1995). Escaped or released Eagle Owls? *Yorkshire Birding* **4** (2): 60-61.

Warburton, A. (2008). Feathers fly over UK Eagle Owls once again. Published online, http://www.owls.org/News/feathersfly.htm (page visited 14/02/2008).

Wink, M. & Heidrich, P. (1999). Molecular evolution and systematics of the owls (Strigiformes). In "Owls. A guide to owls of the world". (Eds. C. König, F. Weick & J.-H. Becking), Pica Pres, Robertsbridge.

Zuberogoitia, I., Torres, J.J. & Martinez, J.A. (2003). Reforzamiento poblacional del Búho Real *Bubo bubo* en Bizkaia (España). *Ardeola* **50** (2): 237-244.