Information about GB Non-native Species Risk Assessments

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

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

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

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

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

Common misconceptions about risk assessments

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

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

Period for comment

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

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

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism	***Corvus splendens* - Indian House Crow**
	Objectives:	Assess the risks associated with this species in GB
	Version:	FINAL 22/03/11
	Author:	D. Parrott (Fera)
	Suggested citation:	Parrott, D. (2011). GB Non-native Organism Risk Assessment for *Corvus splendens*. www.nonnativespecies.org

N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the Risk Assessment?		Request from the GB Programme Board
2	What is the Risk Assessment area?	GB	
3	Does a relevant earlier Risk Assessment exist?	YES (Go to 4)	
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	PARTLY VALID OR NOT VALID (Go to 5)	Partly valid. The current risk assessment contains further details and expands on the earlier (2004) assessment.
A	**Stage 2: Organism Risk Assessment** **SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Corvus splendens* (Viellot 1817) (Indian) House Crow Passeriformes - Aves - Animal
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 Indian House Crow is regarded as a widespread and notorious pest in Asia and Africa (Brook *et al*. 2003). It is a voracious predator of eggs, chicks and adults of other bird species (Long 1981, Cramp 1994, Puttoo & Archer 2003, Yap & Sodhi 2004), causes displacement of indigenous bird species through competition and aggression (Long 1981, Ryall 1992, Cramp 1994, Brook *et al*. 2003), kills young domesticated animals and pets (Cramp 1994, Puttoo & Archer 2003), causes damage to fields of crops, e.g. cereals, maize and sunflower (Dhindsa *et al*. 1991, Cramp 1994, Khan 2003), and poses potential health risks to humans and livestock via disease transmission (Roy *et al*. 1998, Puttoo & Archer 2003).
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?	NO (Go to 11)	
10	Is the organism widely distributed in the Risk Assessment area?		
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 Indian House Crow is omnivorous with a wide-ranging and opportunistic diet, consuming a variety of plants and animal species. In its native and introduced range it is closely associated with people, taking advantage of scavenging opportunities provided by discarded food items and refuse dumps. No populations are known to live independently of man (Nyari *et al*. 2006). The required resources are abundant in urban and sub-urban areas in the Risk
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)	See above.
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)	Although native to India and present in Africa and the Middle East, the House Crow is now also breeding in the Netherlands, which has an ecoclimatic zone similar to the Risk Assessment Area. The Dutch birds have survived winter temperatures as low as -8°C (Ryall 2002). There are also records of individual House Crows from other European countries - Denmark, France, Hungary, Ireland, Poland and Spain (Ryall 2002, Ottens & Ryall 2003). In some cases birds are known to have survived for a number of years, e.g. 5 years for the bird recorded in Ireland (Mullarney *et al*. 2000).
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?		
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 Indian House Crow has established breeding colonies in *c*.20 tropical and sub-tropical countries outside its native range; sightings of solitary birds have been reported from a further 12 countries (Ottens & Ryall 2003). More recently, the species has established and bred (1997) in the Netherlands, NW Europe (Ottens 2003). From two birds in 1994 the population at Hoek van Holland (near Rotterdam) increased to 14 individuals by 2002 (Ottens 2003). A number of additional individuals have also been observed at other coastal sites. Global spread has occurred through natural expansion, and by deliberate and accidental introductions. House Crows were deliberately introduced into a number of countries for a variety of purposes, including biocontrol (e.g. caterpillars in Malaysia, Cramp 1994; livestock ticks in Oman, Ryall 1994) and to clean up refuse (e.g. Zanzibar, Ryall 1994). Accidental introductions (including the Netherlands) have been ship-assisted (Long, 1981, Jennings 1992, Ottens 2003, Ottens & Ryall 2003); the Dutch colonisers possibly originated from Suez, Egypt (Ottens 2003). The main pathway of introduction has been ship-assisted transfer (Ryall 2003).

17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	The majority of new sightings are from ports and other coastal locations, supporting the view that most spread is ship-assisted, although some records may be attributable to deliberate releases or escapes of captive birds (Ryall 2002). Once arrived in a new area, birds can spread via natural flight. One record of successful captive breeding for Great Britain and Ireland (Cleeton 2001). This is the only known reference to House Crows in captivity in GB.
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)	Potentially significant impact as a predator of other avian species - the House Crow is a predator of eggs, chicks and adults of a wide range of bird species (Ryall 1992). Also, unknown, but potential detrimental impact on gamebird and free-range poultry production - House Crows have predated eggs and chicks of free-range poultry (Puttoo & Archer 2003), and on agriculture - House Crows are known to consume a range of crops (Bhardwaj 1991, Khan 2003, Dhindsa *et al* . 1991), although species mainly resides in urban and semi-urban areas rather than rural. There is also the potential for social and health impacts - communal roosts can be a source of noise nuisance and faecal deposition. The House Crow's scavenging habits and close association with man would facilitate disease transmission.
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**	**UNCERTAINTY**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	very few - 0	LOW - 0	(I) Ship-assisted transfer, (ii) natural expansion via flight.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.	Ship-assisted transfer		The majority of new sightings are from ports and other coastal locations, supporting the view that most spread is ship-assisted (Ryall 2002, 2003). Birds have also been observed travelling on ships and alighting at ports of entry (Ryall 1994, 2002). This pathway is believed to have been the source of the present population in the Netherlands (Ryall 1995), and for a single bird, in 1974, recorded at a small fishing port in Dunmore East, County Waterford, Ireland (Mullarney *et al*. 2000). Another sighting of a House Crow occurred in 1997 on Bournemouth seafront (Ryall 2002), although this may have been a mis-identifed hooded crow *Corvus corone cornix* (Ottens & Ryall 2003).
1.3	How likely is the organism to be associated with the pathway at origin?	very likely - 4	LOW - 0	There is a population of House Crows at Hoek van Holland, Rotterdam, the site of which lies close to a major shipping route and port. House Crow colonies are located in or near ports and harbours and along coasts throughout its range in Asia, Africa and the Middle East (Ryall 1994, 2002).
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	likely - 3	LOW - 0	Numbers of individuals roosting or scavenging at ports varies but can be relatively high, e.g. 50-150 birds present throughout the day and *c*.750 roosting overnight, in Port Tewfik, on the Suez Canal, in 1984 (Bijlsma & Meininger 1984).
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	LOW - 0	There are no known specific practices for preventing House Crows gaining access to ships at ports of origin, surviving onboard or alighting at ports of entry.
1.6	How likely is the organism to survive or remain undetected by existing measures?	unlikely - 1	LOW - 0	Colonising individuals are unlikely to remain undetected. Individuals should quickly be detected by the birdwatching community. However, initial mis-identification (e.g. as hooded crow) has occurred in past records of House Crow sightings (Ryall 2002). Individuals could escape attention at ports but not for long in gardens or the countryside.
1.7	How likely is the organism to survive during transport /storage?	very likely - 4	LOW - 0	House Crows are able to survive long ocean crossings, demonstrated by their appearance on the east and west coasts of the USA, Chile and Barbados (Ryall 2002).
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	very unlikely - 0	LOW - 0	Breeding attempts during transport are extremely unlikely.
1.9	What is the volume of movement along the pathway?	minimal - 0	LOW - 0	Shipping volumes (cargo and passenger vessels) between India/Middle East/South Africa/NW Europe and the Risk Assessment Area are high. Records of House Crows observed travelling aboard ships indicate that they do so in relatively low numbers, i.e. one or a few birds (Ryall 1994, 2002). The volume of movement of actual House Crows by ship-assisted transfer to the UK will, therefore be minimal.
1.10	How frequent is movement along the pathway?	very rarely - 0	LOW - 0	There are daily movements of ships (cargo and passenger vessels) between ports at which the species occurs (including Rotterdam) and the Risk Assessment Area. However, there is a very low chance of a bird/s travelling onboard an individual ship. A relatively low frequency of movement of actual House Crows to a particular area is illustrated by Ryall's (2002) records of >50 arrivals in Western Australia and Victoria since the 1920s and June 2000 - equating to less than one arrival a year. The frequency of movement of actual House Crows by ship-assisted transfer to the UK will, therefore, be very rare.
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	widely - 3	MEDIUM -1	In the Risk Assessment Area there are a number of widely distributed major ports receiving shipping from regions of the world occupied by the Indian House Crow, e.g. Liverpool, Southampton and London. House Crows, however, have been recorded at smaller ports, e.g. Dunmore East (small fishing port) in County Waterford, Ireland (Mullarney *et al*. 2000). There are also ferry routes between the site of the Dutch population of House Crows and ports on the east coast of England - Hoek van Holland/Harwich and Rotterdam Europort/Hull. Records on the distribution of the House Crow indicate that populations are largely restricted to coastal areas (Bijlsma & Meininger 1984, Ryall 1994, 2002). Where there are suitable resources, however, House Crows can also be found further inland (e.g. Yemen, Ryall 1994; Utrecht, Netherlands, Ottens & Ryall 2003). House Crows arriving at a UK port would have suitable resources either on the coast or further inland.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	very likely - 4	LOW - 0	Could establish during any month of the year. In the Netherlands, individual birds have survived a series of winters, with temperatures as low as -8°C (Ryall 2002).
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	N/A		
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	very likely - 4	LOW - 0	Could transfer very quickly from ship to shore. Would then quickly and easily locate suitable foraging and roosting habitat.

	Probability of Establishment	RESPONSE	UNCERTAINTY	COMMENT
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	very similar - 4	LOW - 0	Although not similar to climatic conditions in its native range and most of its introduced range, the House Crow is able to survive and breed in the Netherlands, which has a very similar climate to the UK.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	very similar - 4	LOW - 0	The UK's other abiotic factors are very similar to the Netherlands, where the House Crow has established a breeding population.
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	The House Crow is an omnivorous scavenger. As a generalist no single species is “vital” for its survival, development and multiplication. 'Relevant' prey species and other sources of food and habitat are varied and abundant in the Risk Assessment Area.
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	The species is an omnivorous scavenger which inhabits urban/semi-urban habitat. As a generalist no specific species are “vital” for its survival, development and multiplication. Potential food sources are plentiful in this habitat in the form of small birds and mammals and discarded and dumped waste food products.
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		
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	Although resident corvids all predate or scavenge similar prey/food sources, the Indian House Crow is unlikely to be out-competed. It seems able to succeed in competition with other scavenging species in urban/semi-urban habitat where it has been introduced (Goodwin 1976). There are reports of the House Crow displacing other scavenger species from urban areas in a number of introduced countries, including the Pied Crow *Corvus albus* in Mombassa, Malindi and Zanzibar, the Hooded Crow (*Corvus corone sardonius*) in Suez, and Black Kites *Milvus migrans* in Mombassa, Dar es Salaam and Aden (Ryall 1992).
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	Similar species (e.g. carrion crow, *Corvus corone*) in the UK have few indigenous predators. House Crows have been observed to harass and mob a variety of raptors (Ryall 1992). House Crows are, however, preyed upon by Peregrine Falcons (*Falco peregrinus*) and Great Sparrowhawks (*Accipiter melanoleucus*) (Ryall 2002).
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	House Crows are most abundant in areas where they can benefit from improper human food and refuse handling, such as commercial areas, public housing areas and urban parks (Lim *et al.* 2003). Man’s management of the environment/habitat in the Risk Assessment Area is similar to that in the Netherlands. However, it is not yet clear whether environment/habitat conditions in NW Europe will facilitate establishment as effectively as in countries in Asia, Africa and the Middle East.
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	Some resident corvid species can be shot/trapped under general licence. However, this is not considered to have a detrimental impact on their populations. Any ongoing local lethal corvid control will tend to be carried out in rural areas rather than urban/suburban areas, where colonisation by House Crows would first occur. Such control is, therefore, very unlikely to inadvertently encompass and remove any colonising House Crows.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	N/A		
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	moderately likely - 2	LOW - 0	In India, the House Crow typically lays a single clutch of 4 eggs (range 2 to 5) (similar to crows in the UK), whilst in Kenya they can be double-brooded (Cramp 1994). In the Netherlands, a breeding pair produced a single fledgling in 1997 and 1998, and at least one fledgling in 2000 (Ryall 2003). The House Crow has proven its ability to breed successfully in northern Euope, but it is possible that reproductive output is lower in temperate Northern Europe than in its tropical and sub-tropical range.
1.26	How likely is it that the organism’s capacity to spread will aid establishment?	likely - 3	LOW - 0	House Crows have a proven capacity to increase in numbers and spread, following introduction to new areas. Although regarded as sedentary (Cramp 1994), they will travel up to *c*.15km on foraging trips (Ottens & Ryall 2003).
1.27	How adaptable is the organism?	adaptable - 3	LOW - 0	The species original range lies in the Indian sub-continent in sub-tropical and tropical lowlands and hills (Cramp 1994). Following range expansion, it is now widespread in Asia, Africa and the Middle East, and has also recently established a breeding colony in the Netherlands in temperate northern Europe. It is the species of corvid most adapted to living alongside humans and exploiting associated resources.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	likely - 3	MEDIUM -1	In the Netherlands, the population at Hoek van Holland increased from two birds in 1994 to 14 birds in 2002. The House Crow has repeatedly established populations in new countries following the arrival of ship-assisted, small founder
1.29	How often has the organism entered and established in new areas outside its original range as a result of man’s activities?	many - 3	LOW - 0	The Indian House Crow has established breeding colonies in *c.* 20 tropical and sub-tropical countries outside its native range; sightings of solitary birds have been reported from a further 12 countries (Ottens & Ryall 2003). House Crows were deliberately introduced into a number of these countries for a number of purposes, including biocontrol (e.g. caterpillars in Malaysia, Cramp 1994; livestock ticks in Oman, Ryall 1994) and to clean up refuse (e.g. Zanzibar, Ryall 1994). Most introductions are belived to have been accidental ship-assisted transfers (including the Netherlands) (Long, 1981, Jennings 1992, Ottens 2003, Ottens & Ryall 2003).

1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	unlikely - 1	MEDIUM -1	It would be possible to shoot colonising individuals. Eradication is most likely to be achievable if control is undertaken while numbers are relatively small and range restricted. Failure to establish in Australia, following repeated ship-assisted introductions (>50 arrivals) has been due to the vigilance of the authorities and a policy of 'shooting-on-sight' (Ryall 1994, 2002). The small, localised population in Hoek van Holland could be relatively easily controlled. However, control and/or eradication programmes that have been implemented where populations have become established over the long-term have almost universally failed, e.g. Kenya, Malaysia, Mauritius, Singapore, South Africa, Yemen (Aden) and Zanzibar (Brook *et al*. 2003, Ryall 2003); only in the Seychelles has complete eradication been possible (Ryall 2003). Thus, during early establishment eradication would be possible but if significant establishment was allowed, eradication would be extremely difficult.
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	Transient populations could be maintained in the Risk Assessment Area. Sightings have been recorded in a number of European countries - Ireland (1974), Denmark (1986 and 1996), England (1997), France (2000 and 2001), Gibraltar (1991), Hungary (2002), Spain (1991) and Poland (2002) (Ryall 2002, Ottens & Ryall 2003). Although establishment of breeding has not yet occurred in these countries, individuals have survived for up to five to seven years, increasing the likelihood of breeding in the event of further arrival/s (Ryall 2002). Arrivals are more likely if the population in the Netherlands persists where House Crows have been recorded in all coastal provinces (Ottens & Ryall 2003) and have established a satellite colony in den Haag (Nyari *et al*. 2006).

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	slow - 1	MEDIUM -1	In the Netherlands, spread has been slow. The first records of House Crows were in 1994, with first breeding in 1997 (Ottens & Ryall 2003). The population reached 14 individuals in 2002 (Ottens 2003). The occurrence of up to four birds at Den Haag, Zuid-Holland, in 2003, could indicate dispersal from Hoek van Holland (Ottens & Ryall 2003) - a distance of approximately 15km. Individuals sighted in other provinces of the Netherlands (Renesse, Utrecht, Groningen and Zeeland) greater than 15-25km from Hoek van Holland are considered to be birds with no connection to the population at Hoek van Holland (Ottens & Ryall 2003). Elsewhere in its established range, the House Crow is regarded as sedentary (Cramp 1994), but will make trips of around *c*.15km to forage; it is possible that some of the solitary Dutch birds have been travelling further during exploratory flights (Ottens & Ryall 2003).
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	slow - 1	LOW - 0	House Crows would not spread by direct human assistance within the Risk Assessment Area, but human-induced conditions would benefit the species, e.g. waste food, bird-food in gardens, carrion from road kills, etc.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	easily - 1	LOW - 0	The species could be relatively easy to contain within the area of establishment, but only if control is undertaken while numbers are relatively small and their range restricted. A 'shoot-on'sight' policy towards colonising individuals has successfully prevented establishment of House Crows in Australia.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.		LOW - 0	Throughout its global distribution the House Crow exists in close association with man, almost exclusivley along coastal strips. Therefore, the area endangered by the species is urban, semi-urban and peri-urban habitats throughout the Risk Assessment Area, with an emphasis on coastal areas.

	Impacts	RESPONSE	UNCERTAINTY	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	moderate - 2	MEDIUM -1	In India, the House Crow is reported to raid crops such as wheat and maize, and to cause severe damage to fruit in orchards (Long 1981), and to fields of oats and maize (Cramp 1994). Other crops damaged in India are ripening sunflower (Dhindsa *et al*. 1991) and almonds (Bhardwaj 1991). In Pakistan, the House Crow is regarded as a serious pest, consuming maize, sunflower and harvested wheat (Khan 2003). In Mauritius, production of free range poultry was affected by predation on eggs and chicks (Puttoo & Archer 2003). No environmental, economic or social impacts have been reported from Hoek van Holland. There is no information on the diet of the Dutch colony, but presumably it will be simlar to other corvids lining in an urban environment.
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?	minor - 1	MEDIUM -1	Unknown, but potential, impact on gamebird and free-range poultry production, and agricultural crops. Impacts, however, will be mitigated through the species mostly residing in urban/semi-urban areas rather than rural. Throughout its range, the House Crow feeds primarily on human refuse, stolen scraps and road kills (Ryall 1992).
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	See above.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	See above.
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	See above.
2.10	How important would other economic costs resulting from introduction be? (specify)	moderate - 2	LOW - 0	Moderate costs for monitoring and control measures.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	major - 3	LOW - 0	The House Crow is regarded as having a serious impact on other bird species through predation and harassment. It is a predator of eggs, chicks and adults of other bird species (Balasubramanian 1988, Cramp 1994, Ryall 1992, Puttoo & Archer 2003, Yap & Sodhi 2004). Ryall (1992) listed 13 species, in Mombassa, Kenya, which had been observed to be preyed upon. Colonial nesters, such as weavers, appear to be particularly vulnerable, although solitary nesters are also predated (Ryall 1992). Dramatic declines in the populations of further species have been associated with an increasing House Crow population, although no direct reports of predation (Ryall 1992, Puttoo & Archer 2003, Daniels 2004). The House Crow also displaces indigenous bird species through competition and aggression - Ryall (1992) listed 22 species that were harassed and mobbed. House Crows are reported to have displaced other scavenger species from urban areas in a number of introduced countries, including the Pied Crow *Corvus albas* in Mombassa, Malindi and Zanzibar, the Hooded Crow *Corvus corone sardonius* in Suez, and Black Kites *Milvus migrans* in Mombassa, Dar es Salaam and Aden (reviewed in Ryall 1992).
2.12	How important is environmental harm likely to be in the Risk Assessment area?	major - 3	LOW - 0	Indian House Crows predate a wide range of other bird species, from colonial nesters to solitary nesters. Impacts are likely to be low during the early stages of establishment. In the Netherlands, populations of important colonies of common tern *Sterno hirundo* and pied avocet *Recurvirostra avosetta* are present within 8km of Hoek van Holland, but to date no House Crows have been observed in the vicinity of these colonies (Ryall 2003). If an establishing population is allowed to expand, however, impacts will become major.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	major - 3	MEDIUM -1	Indian House Crows are regarded as a public nuisance in a number of countries. The birds roost communally and can involve thousands of individuals (Cramp 1994). Such large roosts in urban areas create high levels of noise pollution and faecal contamination (Jennings 1992, Brook *et al*. 2003). Together with scavenging from refuse tips, streets and from human residences these behaviours present risks to public health. House Crows have been shown to carry organisms deterimental to human health, including *Salmonella* and *Escherichia coli* (Jennings 1992), and that of livestock, including Newcastle Disease (Roy *et al.* 1998). The species is also a potential reservoir for West Nile Virus and avian influenza (Nyari *et al.* 2006). There are reports of Indian House Crows attacking domesticated animals and pets (Jennings 1992, Cramp 1994), and people (Brooks *et al*. 2003).
2.14	How important is the social harm likely to be in the Risk Assessment area?	moderate - 2	MEDIUM -1	Impacts are likely to be low during the early stages of establishment. If an establishing population is allowed to expand, however, impacts will become greater.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	LOW - 0	Not applicable to this species.
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	Similar species (e.g. carrion crow) in UK have few indigenous predators.
2.17	How easily can the organism be controlled?	with some difficulty - 2	MEDIUM -1	Individual colonising birds could be shot. Failure of the House Crow to establish in Australia, following repeated ship-assisted introductions (>50 arrivals) has been due to the vigilance of the authorities and a policy of 'shooting-on-sight' (Ryall 1994, 2002). Control of a small, geographically restricted population, such as in Hoek van Holland, would also be relatively straight-forward. Ryall (2003), however, warns that the crows are wary and fast learning. Control would become increasingly difficult as the population expanded. Control/eradication of long-established populations in other countries have almost universally failed.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	very unlikely - 0	LOW - 0	Shooting would be little different to existing control (under General Licence) of native corvids, and other avian pest species. Other control techniques used against the House Crow include destruction of eggs and chicks, trapping, stupefying baits and poisoning (Feare & Mungaroo 1990, Jennings 1992, Puttoo & Archer 2003, Wai-Hung *et al*. 2007). Those techniques that are legal in the UK are very unlikely to disrupt existing control of other organisms.

2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	moderately likely - 2	MEDIUM -1	As with a number of other bird species which live in close proximity to man, the House Crow is a potential vector for human pathogens such as *Salmonella* and *Eschericia coli* (shown to be carried by House Crows - Jennings 1992). However, there are very few cases of demonstrable disease transmission between wild birds and man (Thearle 1968; Weber 1979).
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur		LOW - 0	Those parts of the Risk Assessment Area which are primarily endangered are urban/semi-urban areas surrounding ports which receive shipping from countries within the existing range of the Indian House Crow (potential for ship-assisted transfer). These UK coastal regions are also the primary areas predicted for the potential distribution of the House Crow based on ecological niche models (Nyari *et al* . 2006). Environmental and social impacts are most likely to occur in gardens, parklands and immediate surrounding countryside; further impacts are likely in areas with improper disposal of human food, including housing and commercial areas.

Summarise Entry	likely - 3	LOW - 0	The spread of the Indian House Crow into the Netherlands has proven the species' ability for ship-assisted entry into NW Europe, from its previous range restricted to the southern hemisphere. With the establishment of the species in the Netherlands, and increasing occurrences of individuals in northern Europe, there is an increased likelihood of the species entering the Risk Assessment Area, either by ship-assisted transfer or natural flight. The latter pathway is less likely as the species is generally sedentary.
Summarise Establishment	likely - 3	LOW - 0	The Indian House Crow has already demonstrated its ability to establish a population in a temperate NW European country, i.e. the Netherlands. Abiotic and biotic conditions in the Risk Assessment Area are similar to those in the Netherlands. Therefore, with abundant food resources, few natural enemies and the ability to out-compete resident corvid species in urban/semi-urban/peri-urban habitats, the potential for the House Crow to establish following entry is high.
Summarise Spread	slow - 1	LOW - 0	Once established, the House Crow has the potential to spread throughout urban/semi-urban/peri-urban habitat. In its native range, however, it is regarded as sedentary. House Crows are not known to undertake long distance flights; typical foraging trips are up to *c.* 15km (Ottens & Ryall 2003). In the Netherlands, since its arrival in Hoek van Holland in 1994, House Crows have been recorded in all coastal provinces of the Netherlands (Ottens & Ryall 2003). The occurrence of up to four birds at Den Haag, Zuid-Holland, in 2003 could indicate dispersal from Hoek van Holland. The records of other individuals, further than 15-25km, however, are likely to be other colonisers, separate from the Hoek van Holland birds.
Summarise Impacts	major - 3	LOW - 0	The Indian House Crow, which occupies urban/semi-urban/peri-urban habitat, is regarded as a widespread major pest in Asia and Africa. It is a major predator of other birds, and is implicated in reductions in populations of a range of species. In addition to direct predation, it also displaces indigenous avian species through competition and aggression. Further problems are associated with public health issues arising from the House Crow's communal roosting and scavenging behaviours.
Conclusion of the risk assessment	MEDIUM -1	LOW - 0	Likelihood of entry, by ship-assisted transfer, is highest if the population in the Netherlands is allowed to persist and expand. Colonisation of further European countries, including the UK, is highly likely to originate from there. Entry could also originate via ship-assisted transfer from other countries within its existing range. On entry the species is highly likely to establish successfully; it specialises in exploiting resources in urban areas and has repeatedly proven its ability to successfully invade new areas. Principal risk area comprises urban/semi-urban/peri-urban habitat around ports and along coasts. The most important potential impacts are environmental with significant predation of local avifauna.
Conclusions on Uncertainty		LOW - 0	This risk assessment is reliable. There is widespread evidence and recognition of the species' ability to expand its geographic range and to impose detrimental impacts in its native and introduced range. Repeatedly, introductions have been followed by the establishment of a breeding population and major impacts on native avifauna. Similar damage could occur in the Risk Assessment Area following entry and establishment. Concerns have been raised for the avifauna of NW Europe (including the Risk Assessment Area) following the recent establishment and breeding of the species in the Netherlands.

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