

Bar-headed goose (*Anser indicus*)

- Ornamental bird with a wide native range covering mountainous region of central Asia (breeding range) and lowlands of the Indian subcontinent and southeast Asia (winter range).
- Commonly kept in private collections.
- A small population is present in GB although this is stable and not increasing.
- In large numbers may lead to reductions in numbers of small waterbird species and impacts on grassland and water quality.



Richard Bartz, Wikimedia Commons 20167

History in GB

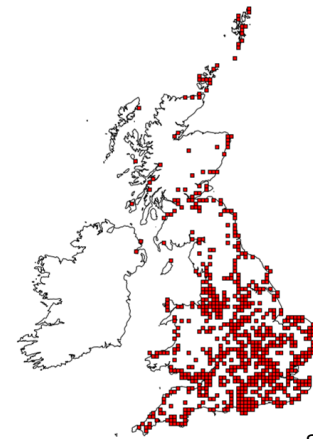
Known to have been present in GB since at least 1972 and were found breeding in the wild by 1989. In 1991 a total of 83 individuals were counted during a GB survey. Currently a small population is present, estimated at 22 birds in 2014/15, however this may be an underestimate. All birds in GB (and other European countries) are of captive origin. Most records occur in the south and east of GB. Populations in GB are described as stable and not increasing.

Native distribution

Breeding range covers mountainous regions of central Asia (Mongolia, western China, Kyrgyzstan and Tajikistan) and winter range covers the lowlands of the Indian subcontinent and southeast Asia.

[map not available]

Distribution in GB (map shows sightings)



Source: NBN 2017

Impacts

Environmental (moderate)

- Bar-headed geese are aggressive and large numbers of breeding birds could have a detrimental affect on numbers of small waterbird species.
- Large numbers of geese could also impact on grassland and water quality through trampling and eutrophication, however these are not impacts which have been associated with this species.

Economic (moderate)

- Likely to have similar impacts to other non-native geese already established in GB particularly damage to crops through grazing and trampling.
- Potential bird strike risk to aircraft.

Social (minimal)

- Potential vector for avian influenza although unlikely to have an impact on the epidemiology of this disease.
- Large numbers of goose droppings could cause a human health hazard although this has not been reported to date as bird numbers are low.

Introduction pathways

Ornamental - commonly kept in captivity in GB and Europe.

Escapes are common and the source of all feral birds in Europe.

Spread from European populations - self-sustaining populations are established in the Netherlands and Belgium, it is possible that birds could spread across the channel to GB.

Spread pathways

Natural (intermediate) - this species is highly mobile and if numbers were to increase in GB, birds are likely to colonise new breeding areas. Without control measures this species may increase considerably within the next 50 years.

Human-aided (slow) - future escapes from captivity are likely, although the number of locations from which birds can escape is unlikely to increase dramatically.

Summary

| | Risk | Confidence |
|---------------|---------------------|------------------|
| Entry | VERY LIKELY | VERY HIGH |
| Establishment | LIKELY | HIGH |
| Spread | INTERMEDIATE | MEDIUM |
| Impacts | MODERATE | MEDIUM |
| Conclusion | MEDIUM | MEDIUM |

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@apha.gsi.gov.uk

GB Non-native Species Rapid Risk Assessment (NRRAP)

Rapid Risk Assessment of: *Anser indicus* (Bar-headed goose)

Author: Rebecca Jones, Animal and Plant Health Agency (APHA)

Version: Draft 1 (*April 2012*) – Lee Johnson APHA, Peer Review (*18-03-13*), NNRAP 1st review (*25-10-13*), Draft 2 (*November 2016*)

Signed off by NNRAP: November 2016

Approved by Programme Board: February 2017

Placed on NNSS website: April 2017

Introduction:

The rapid risk assessment is used to assess invasive non-native species more rapidly than the larger GB Non-native Risk Assessment. The principles remain the same, relying on scientific knowledge of the species, expert judgement and peer review. For some species the rapid assessment alone will be sufficient, others may go on to be assessed under the larger scheme if requested by the Non-native Species Programme Board.

Guidance notes:

- We recommend that you read all of the questions in this document before starting to complete the assessment.
- Short answers, including one word answers, are acceptable for the first 10 questions. More detail should be provided under the subsequent questions on entry, establishment, spread, impacts and climate change.
- References to scientific literature, grey literature and personal observations are required where possible throughout.

1 - What is the principal reason for performing the Risk Assessment? (Include any other reasons as comments)

Response: To rapidly assess the risk associated with this species in Great Britain. The Bar-headed goose was identified by a GB horizon scanning exercise as a 'medium risk species either present, enclosed, or absent in Great Britain' (Parrot et al., 2009)

2 - What is the Risk Assessment Area?

Response: Great Britain

3 - What is the name of the organism (scientific and accepted common; include common synonyms and notes on taxonomic complexity if relevant)?

Response: *Anser indicus* (Bar-headed goose). Monotypic species (Takekawa et al., 2009).

4 - Is the organism known to be invasive anywhere in the world?

Response: Yes. Bar-headed geese are established, increasing and spreading in the Netherlands and Belgium, where the estimated breeding population in 2007 was 100-125 and 25-30 breeding pairs, respectively (Banks et al., 2008; Van Horssen & Lensink, 2000). Numbers here are increasing, with estimates of up to 310 breeding pairs in the Netherlands in 2012 (Waarneming, 2016).

Breeding occurs regularly in France, Germany, and the United Kingdom, but populations here are stable at present and cannot be said to be established and self-sustaining (Banks et al., 2008). Breeding has also occurred in Switzerland, Italy, Norway, Sweden, Finland, the Czech Republic, Romania, the Ukraine, but remains irregular and has not resulted in established self-sustaining populations (Kampe-Persson, 2010; Banke et al., 2008; Van Horssen & Lensink, 2000). The species is also present in Canada and the United States of America (CABI, 2016).

5 - What is the current distribution status of the organism with respect to the Risk Assessment Area?

Response: A small population is already present in GB. All birds in GB (and other European countries) are of captive origin (Parrott et al., 2009; Kamper-Persson, 2010). The species was first recorded in the 1960s (Banks et al., 2008). An estimated 100 individuals currently live in the UK (Banks et al., 2008). A total of 83 individuals were counted during a GB survey in 1991 (Delaney, 1992). Winter WEBs counts for winter 2014/2015 estimate a maximum number of 22 birds (BTO, 2016). This appears to indicate a recent decline in numbers, but care should be taken when interpreting this data as under-reporting is likely. Birds are widely dispersed in small numbers that often associate with other goose species such as Greylag (*Anser anser*) and Canada goose (*Branta canadensis*) (NNSS, 2016; Holling et al., 2014; Banks et al., 2008). Although scattered, most records occur in the south and east of GB (Balmer et al., 2013), see maps below. Winter presence is estimated at 5% of the area of GB, while breeding presence is < 1% (Balmer et al., 2013).

Breeding records are few, although probably under-reported (Banks et al., 2008). The UK RBBP report for the period 2009-2011 classifies the species as a regular breeder, having bred in 9 out of the 10 previous years, with a mean breeding population for the previous 5 years of 2 breeding pairs (Holling et al., 2014). The UK RBBP report for the period 2006-2008 states that two pairs bred in 2007, while between 1 and 3 pairs bred in 2008 (Holling et al., 2011). This is fewer than bred in the late 1990s, with up to 8 pairs having bred in 1999 (Holling et al. 2011). Banks et al. (2008) estimated the annual numbers of breeding pairs in the UK to be 5 for the period 1996-2002 and 1-3 for the period 2004-2007. The population is deemed to be stable, not increasing, and not self-sustaining (Holling et al., 2014, Banks et al., 2008).

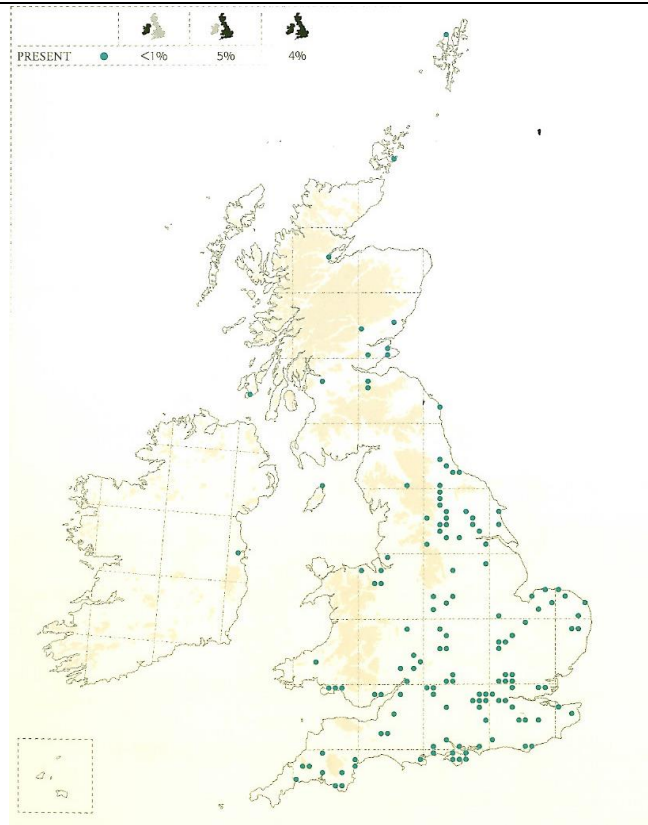
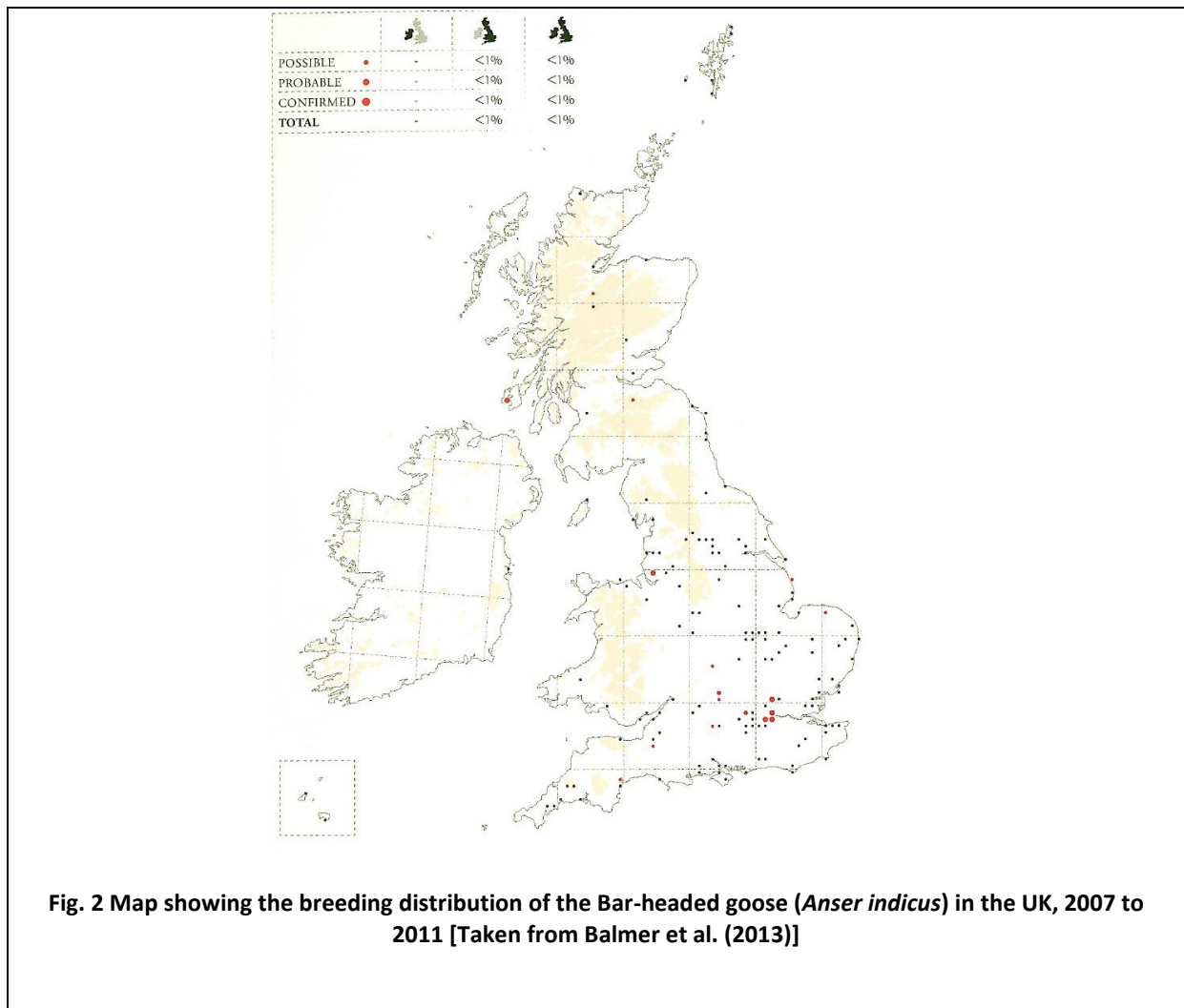


Fig 1. Map showing the winter distribution of the Bar-headed goose (*Anser indicus*) in the UK, 2007/08 to 2010/11 [Taken from Balmer et al. (2013)]



6 - Are there conditions present in the Risk Assessment Area that would enable the organism to survive and reproduce? Comment on any special conditions required by the species?

Response: Yes. In its native state, the Bar-headed goose occupies a wide climatic range (CABI, 2016; Takekawa et al., 2009). It has long been popular in European waterfowl collections, where it adapted well to local conditions and was relatively easy to breed (Reeber, 2015). The species has already bred successfully in GB, as well as in several other European countries. Bar-headed geese prefer grassland and agricultural areas close to freshwater (Weername, 2016, Parrott et al., 2009) and there are many such areas in GB. It usually nests near freshwater on the ground, although it has been known to nest in trees using the old nests of other species (Mooij et al., 2010). Established populations in the Netherlands and Belgium have all been close to water such as rivers (Van Horssen & Lensink, 2000). The species' diet consists mainly of grasses, cereals, and other aquatic and terrestrial plants (CABI, 2016; Banks et al., 2008), and grasslands and other agricultural areas are not in short supply in GB. It is also a highly mobile species, and is thus able to move to find available food sources and suitable nesting sites when necessary (Takekawa et al., 2009; Anselin & Vermeersch, 2005; Van Horssen & Lensink, 2000). It is also possible that feeding of waterfowl by the public in recreational areas could help the species to survive the winter and increase its breeding success.

7 - 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?

Response: Yes. In its native state, the Bar-headed goose occupies a wide climatic range (CABI, 2016; Takekawa et al., 2009), breeding at high altitudes where temperatures are relatively cool, and wintering in tropical and sub-tropical regions (Birdlife International, 2016; Takekawa et al., 2009). Although winters in Western Europe are likely cooler than those in its native wintering grounds, the species seems to have adapted well to local climates whenever kept in European waterfowl collections, and feral populations in Europe have bred successfully and are often sedentary, surviving local winters without the need to migrate (Reeber, 2015; Van Horssen & Lensink, 2000).

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (answer N/A if you have answered 'yes' to question 4)?

Response: N/A

9 - Can the organism spread rapidly by natural means or by human assistance?

Response: Yes. This is a highly mobile species, capable of travelling great distances naturally. In its native state it is highly migratory. It is also capable of dispersive movements for breeding purposes or to find new suitable food sources (Takekawa et al., 2009; Anselin & Vermeersch, 2005; Van Horssen & Lensink, 2000). Feral birds regularly associate with other goose species and may follow these in their movements (Banks et al., 2008).

This species may also be spread by humans, as it is commonly kept in waterfowl collections, bought and sold by waterfowl breeders, and bred in captivity in Europe. Escapes are common and are the source of all feral birds currently present in Europe (Parrott et al., 2009; Banks et al., 2008).

10 - Could the organism itself, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment Area?

Response:

Yes. The species is potentially an agricultural pest, as it is known to graze crops such as barley, rice, wheat, alfalfa, and radishes, and large numbers could also trample crops (CABI, 2016; Zu-Kuil et al., 2013; Callaghan et al., 2006). However, there are no records of this species as an agricultural pest (NNSS, 2016). It also has the potential to cause problems on amenity grasslands (CABI, 2016) although to date, no problems have been reported (NNSS, 2016; Kumschick & Nentwig, 2010). The species is a potential bird strike risk to aircraft, as a large, flocking, flying bird, and Bar-headed geese have been known to be involved in collisions with aircraft (worldbirdstrike, 2016), but reports are few. The ability of Bar-headed geese to fly at high altitudes is unlikely to make them more of a bird strike risk, as most bird strikes happen below 500 ft. (Kalafatas, 2015), and Bar-headed geese only attain such heights when on migration across the Himalayas. Feral geese, which are mostly sedentary, are unlikely to ever reach such heights. Kumschick and Nentwig (2010) score both the current and the potential economic impact of this species (as a non-native) as 0.

Bar-headed geese often hybridise with other goose species, but as far as is known hybrids are not fertile (CABI 2016; Banks et al., 2008). Banks et al. (2008) gave the Bar-headed goose a risk level (environmental and economic) of 3 out of 7 for the African-Eurasian Waterbird zone, based solely on potential hybridisation with native species. Kumschick and Nentwig (2010) scored the current environmental impact of non-native Bar-headed geese in Europe as 0.042, but the potential impact as 5, based on the potential for hybridisation and competition with native species. However, very few native geese ever breed in GB, so this is not likely to be a major problem. Bar-headed geese can be aggressive towards other species of waterfowl, and Parrott et al. (2009) estimate that large numbers of breeding birds could have a detrimental impact on smaller native waterbirds. Callaghan et al. (2006) scores the risk to biodiversity from this species as low, with no negative impacts recorded, but there is potential for negative impacts due to grazing and potentially competition.

Bar-headed geese are known to be affected by avian influenza, and are therefore a potential carrier for this disease (Feare et al., 2010; Chen et al., 2006; Liu et al., 2005). Large numbers of goose droppings could also cause a human health hazard, although to date this has not been reported, since numbers of birds are low (NNSS, 2016).

Entry Summary

Estimate the overall likelihood of entry into the Risk Assessment Area for this organism (comment on key issues that lead to this conclusion).

Response: *very likely*
Confidence: *very high*

Comments (include list of entry pathways in your comments): Bar-headed geese are already present (~100 individuals) in several parts of GB, with breeding occurring annually (~2 breeding pairs) (Banks et al., 2008; Holling et al., 2014).

Self-sustaining populations are established in the Netherlands and Belgium (~200 and ~30 breeding pairs, respectively), and numbers here are increasing (Waarneming, 2016; Banks et al., 2008; Van Horssen & Lensink, 2000). It is possible that birds could spread from these countries across the channel to GB.

In addition, Bar-headed geese are commonly kept in captivity in GB and the rest of Europe, where they breed readily. Escapes are common and are the source of all feral birds in Europe (Reeber, 2015; Parrott et al., 2009; Banks et al., 2008). It is very difficult to quantify the risk due to this pathway, as there is no legal requirement to register ownership of this or any waterfowl species, so records of the numbers kept in captivity are difficult to come by (Callaghan et al., 2006). A search of an online zoo database (www.zootierliste.de) returned 21 institutions currently holding Bar-headed geese in the UK (zootierliste, 2016). This is likely to be a vast underestimate, as recording is voluntary, and the database is a German one, so institutions outside of Germany although included, are likely to be under-represented. In addition, waterfowl are kept by many private collectors, which will not be represented. Google searches for Bar-headed geese for sale in the UK (conducted on 3/11/2016) returned multiple results. Waterfowl keeping is not strictly controlled and regulations have changed little in recent decades (Callaghan et al., 2006). It is therefore likely that escapes from captivity will continue to occur.

Establishment Summary

Estimate the overall likelihood of establishment (comment on key issues that lead to this conclusion).

[Delete accordingly]

Response: *likely*
Confidence: *high*

Comments (state where in GB this species could establish in your comments, include map if possible): Although numbers of breeding pairs are currently low in GB and the population has not increased for some time, breeding has occurred almost annually since at least the early 1990s (Holling et al., 2014; Banks et al., 2008). The species has therefore been shown to be able to survive and reproduce in GB. In the Netherlands, the Bar-headed goose was present and breeding in low numbers for a long time before numbers began to increase. The first reported case of Bar-headed geese breeding in the Netherlands was in 1977, and between 1986 and 1993 fewer than 10 pairs bred annually. Numbers began to increase substantially from the early 1990s, and the

population is now well established and self-sustaining, with up to 310 breeding pairs estimated in 2012 (Waarneming, 2016; Van Horssen & Lensink, 2000). It is therefore possible that, once a critical population size is reached, numbers could increase exponentially (Parrott et al., 2009; Blair et al., 2000). The numbers of birds in the Netherlands is likely to reflect the number of waterfowl collections and the numbers of escapes, coupled with the abundance of suitable grassland areas close to freshwater (Gyimesi & Lensink, 2012; Van Horssen & Lensink, 2000). Great Britain has large amounts of suitable grassland and agricultural habitat close to freshwater, and given the likelihood of continued breeding, further escapes, and possible spread from the continent, this species has the potential to establish a population in any such area. Potential areas where the Bar-headed goose is likely to become established are likely to be broadly similar to those currently occupied by the Canada goose (*Branta canadensis*), with which it shares many requirements and with which it freely associates (see map of current Canada goose distribution in the UK below).

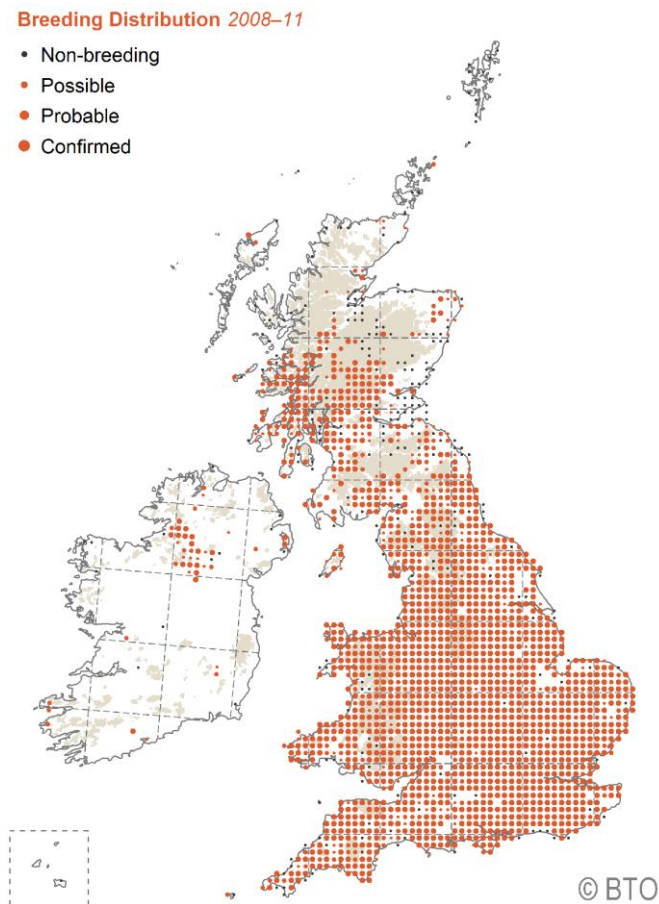


Fig.3. Map showing the current breeding distribution of the Canada goose (*Branta canadensis*) in the UK (Taken from Balmer et al., 2013). The Bar-headed goose (*Anser indicus*) has potential to become established in the same areas.

Spread Summary

Estimate overall potential for spread (comment on key issues that lead to this conclusion).

[Delete accordingly]

Overall response: *intermediate*

Confidence: *medium*

Sub scores:

Natural spread only:

Response: *intermediate*

Confidence: *medium*

Human facilitated spread only:

Response: *slow*

Confidence: *high*

Comments (in your comments list the spread pathways and discuss how much of the total habitat that the species could occupy has already been occupied):

A combination of both spread pathways is likely. This species is highly mobile and if numbers were to increase, birds are likely to colonise new potential breeding areas. The species has increased its range within the Netherlands and it is likely that birds spread from here to Belgium. It is also possible that there has been movement between Scandinavia and the Netherlands (Van Horssen & Lensink, 2000). It is possible that birds could spread across the channel to GB from the continent, and it is also possible that successful breeding in GB could lead to an increase in range within GB.

The likelihood of spread by human-facilitated means is evidenced by the presence of Bar-headed geese of captive origin throughout Europe. Further escapes are likely, although the number of locations from which birds can escape is unlikely to increase dramatically.

The species currently breeds in <1% of GB, and occupies 5% of GB during the winter months (Balmer et al., 2013; see maps in response to Question 5).

Potential habitat for this species (including all months of the year) include grasslands, agricultural land, inland wetlands and inland waterbodies, giving a total area of potential habitat for this species in GB of 157926 km², 67.4% of the total land cover of GB (Knoema, 2016). Currently this species occupies 7.4% of its potential habitat in Great Britain (outside of the breeding season).

It is difficult to predict population growth, as the population trend is currently stable. However, the situation in the Netherlands shows that the population may suddenly begin to increase after a relatively long period of stable, low numbers. With the current population trend, the breeding population of this species and the percentage of its potential habitat occupied is unlikely to be very different in five years, unless a sudden increase occurs.

It is possible that, especially without control measures, the species may increase in numbers considerably within the next 50 years. The likelihood of the population reaching the critical size required for sudden increase within this time is high. If and once this happens, the species will increase dramatically in numbers and spread and within a few decades is capable of achieving a distribution comparable to that of the Canada goose. It could therefore become established in 100% of its potential habitat, or 67.4% of the land cover of Great Britain, in a reasonable worst case scenario. It is, however, possible that competition with other, larger goose species such as the Canada goose and the Greylag goose (*Anser anser*) or other unforeseen factors may limit its population growth.

Estimate overall severity of impact (comment on key issues that lead to this conclusion)

[Delete accordingly]

Overall response: *moderate*

Confidence: *medium*

Sub-scores

Environmental impacts:

Response: *moderate*

Confidence: *medium*

Economic impacts:

Response: *moderate*

Confidence: *medium*

Social impacts:

Response: *minimal*

Confidence: *high*

Comments (include list of impacts in your comments):

Environmental impacts: Although Bar-headed geese have been known to hybridise with other goose species, fertile hybrids are not known, and very few native geese breed in GB, so this is unlikely to be a major issue. Kumschick and Nentwig (2010) list hybridisation as the sole environmental risk associated with this species. However, aggression towards other waterbird species is also a possibility, and Parrott et al. (2009) estimate that large numbers of breeding birds could have a detrimental effect on numbers of smaller waterbird species. Callaghan et al. (2006) scores the risk to biodiversity from this species as low, with no negative impacts recorded, but there is potential for negative impacts due to grazing and potentially competition. Large numbers of geese can also have detrimental effects on grassland quality, through trampling, and water quality, causing eutrophication of lakes (Rehfishch et al., 2010). These are not impacts that have been associated with this species, however.

Economic impacts: The Bar-headed goose is likely to have a similar impact to that of other non-native goose species already established in the UK (e.g. Canada goose, Greylag goose), causing damage to crops through grazing and trampling. The species has been known to graze barley, rice, wheat, alfalfa, and radishes in its native range, but there are no records of it as an agricultural pest except for damage to radishes in China (NNSS, 2016; Zu-Kuil et al., 2013; Callaghan et al., 2006). It has also has the potential to cause problems on amenity grasslands although to date, no problems have been reported (NNSS, 2016; CABI, 2016; Kumschick & Nentwig 2010). Kumschick and Nentwig (2010) score both the current and the potential economic impact of this species (as a non-native) as 0. While damage through grazing is likely, it remains uncertain to what extent the Bar-headed goose would add to the total numbers of geese in GB. Although numbers of other goose species are increasing, there is likely to be a limited carrying capacity for species with such similar requirements. The species is a potential bird strike risk to aircraft, as a large, flocking, flying bird, and Bar-headed geese have been known to be involved in collisions with aircraft (worldbirdstrike, 2016), but reports are few. The ability of Bar-headed geese to fly at high altitudes is unlikely to make them more of a bird strike risk, as most bird strikes happen below 500 ft. (Kalafatas, 2015), and Bar-headed geese only attain such heights when on migration across the Himalayas. Feral geese, which are mostly sedentary, are unlikely to ever reach such heights.

Social impacts: Bar-headed geese are known to be affected by avian influenza, and are therefore a potential carrier for this disease, however this is unlikely to have an effect on the epidemiology of the disease (Feare et al., 2010; Chen et al., 2006; Liu et al., 2005). Large numbers of goose droppings could also cause a human health hazard, although to date this has not been reported, since numbers of birds are low (NNSS, 2016).

Climate Change

What is the likelihood that the risk posed by this species will increase as a result of climate change?

[Delete accordingly]

Response: *low*

Confidence: *high*

Comments (include aspects of species biology likely to be effected by climate change (e.g. ability to establish, key impacts that might change and timescale over which significant change may occur): In its native state, the Bar-headed goose occupies a wide climatic range (CABI, 2016; Takekawa et al., 2009), breeding at high altitudes where temperatures are relatively cool, and wintering in tropical and sub-tropical regions (Birdlife International, 2016; Takekawa et al., 2009). The species seems to have adapted well to local climates whenever kept in European waterfowl collections, and feral populations in Europe have bred successfully and are often sedentary, surviving local winters without the need to migrate (Reeber, 2015; Van Horsen & Lensink, 2000). Warmer conditions are unlikely to cause a problem for the species, and warmer winters, while they may facilitate winter survival, are unlikely to have a large effect, given that it currently tolerates winters in GB and the Netherlands. Colder winters could potentially increase migratory behaviour in the species but are unlikely to affect survival.

Conclusion

Estimate the overall risk (comment on the key issues that lead to this conclusion).

[Delete accordingly]

Response: *medium*

Confidence: *medium*

Comments: The likelihood of establishment, spread, and population increase in the risk assessment area is high, with small numbers already present and breeding annually. Although numbers are currently stable, if a critical population threshold is reached, they could quickly and dramatically increase, and birds are likely to colonise new areas, with large amounts of potentially suitable habitat in GB. Some impacts as an agricultural pest are expected, but are unlikely to exceed those currently caused by Canada goose (*Branta canadensis*) and Greylag goose (*Anser anser*) in Great Britain. Aggressive behaviour towards other native waterbird species may be a problem.

Management options (brief summary):

1 - Has the species been managed elsewhere? If so, how effective has management been?

Response:

It is unclear whether management has occurred in other countries. It seems that some control measures may have occurred on a small scale in the Netherlands (Waarnemen, 2016), but information is scant. If control measures have been used in the Netherlands, they must have been on a relatively small scale, given the lack of information available, and have not prevented the population there from increasing.

2 - List the available control / eradication options for this organism and indicate their efficacy.

Response:

Possible control/eradication methods include destruction of nests and eggs, shooting of adults during the non-breeding (hunting) season, shooting of adults during the breeding season i.e. at nest sites, and rounding up and killing birds during flightless post-breeding moult.

Destruction of nests, egg oiling and/or egg pricking is a possible method of preventing populations from increasing. However, since the species is long-lived and nests are often difficult to find, it would need to be done intensively and over a long period of time to make a difference to the population size. It is likely to be labour-intensive and unlikely to achieve results on its own.

Adding the species to the quarry list for shooting during the hunting season may make a small difference to numbers, but given that this type of shooting occurs outside the breeding season in order to allow numbers of quarry species to remain stable, it is unlikely to have much of an effect. The species is not currently listed as quarry by BASC (BASC, 2016).

Shooting of adults during the breeding season could be effective at reducing numbers and preventing future breeding, assuming nests can be found. Given the strong long-term pair bond in this species, killing one of the pair is likely to prevent breeding for that breeding season and may affect the surviving individual's reproductive output for one or more successive breeding seasons. General licenses to kill this species or to destroy nests or eggs are not currently available (www.gov.uk, 2016).

Killing flightless birds during their post-breeding moult has been an effective strategy for reducing numbers of Canada geese (*Branta canadensis*) and is likely to be effective for this species. During their post-breeding moult, large numbers of geese congregate on waterbodies, where they can be rounded up into a corral and humanely killed. This method allows large numbers of geese to be killed at once, although it has the disadvantage of needing to be times after breeding has already occurred that year.

3 - List the available pathway management options (to reduce spread) for this organism and indicate their efficacy.

Response: Given that all of the non-native Bar-headed geese living in GB and the rest of Europe are of captive origin, stricter regulations on the keeping of these species, marking and registering specimens, and preventing and recording escapes would be key to preventing further entry (Callaghan et al., 2006). Control or eradication measures in other European countries where this species exists as a non-native, particularly the Netherlands and Belgium, would reduce the risk of birds spreading across the channel.

4 - How quickly would management need to be implemented in order to work?

Response: This depends on whether the aim is to control numbers or to eradicate the species from GB. Any

eradication programme should be implemented as soon as possible to have a good chance of success. Given that the species is long-lived and takes several years to reach maturity (Feare et al., 2010) and that it is usually several years after it escapes before it breeds (Anselin & Vermeersch, 2005), rapid response to reports of presence or escape could have significant impact.

References

Provide here a list of the references cited in the course of completing assessment

List:

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