

# American Lobster (*Homarus americanus*)



- Large marine crustacean from north west Atlantic.
- Slightly larger than (but very similar to) our native lobster.
- Not established in GB, but approx 500,000 – 1 million individuals imported into GB annually.
- Occasional but increasing number of escapes from holding facilities.
- Potentially large impacts on native crustaceans if becomes established.

## History in GB

First recorded in the wild in GB waters in 1988, with 14 records in the following 20 years to 2008. Significant increase since 2009 – with peak of 13 individuals found in 2010 (although numbers not systematically recorded). Most reports from south and south-east coasts of England but one recorded in north-east Scotland in 2010. No Welsh records.

## Native distribution

Native to the Atlantic coast of Canada and northern US



Source: Wikimedia 2014, creative commons

## Distribution in EU

Yellow circle indicates occasional or few reports of its presence



Source: Cabi 2013

## Impacts

### Environmental (major)

- Could outcompete native lobster for food and shelter.
- Danger of hybridisation with native lobster (already proven in Norway).
- May compete with edible crab.
- Significant disease risk for native lobsters – white spot syndrome virus and epizootic shell disease and potentially other unknown diseases.

### Economic (moderate)

- Potentially significant economic impact due to loss of native lobster (and even impact on edible crab) fishery.
- Carrier of gaffkaemia disease that infects native lobsters in captivity.

### Social (minimal)

## Introduction pathway

Escape from holding facilities (likely)

Discards from cruise ships (unlikely)

Deliberate release (unlikely)

## Spread pathways

Natural (slow) - although more migratory than the European lobster natural spread is likely to be slow

Human (rapid) - held in facilities throughout GB

## Summary

	Risk	Confidence
Entry	LIKELY	MEDIUM
Establishment	LIKELY	MEDIUM
Spread	INTERMEDIATE	MEDIUM
Impacts	MAJOR	MEDIUM
Conclusion	HIGH	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](http://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](mailto:nnss@apha.gsi.gov.uk)

**PEST RISK ANALYSIS FOR:**

*Homarus americanus*, American Lobster

**Author:** Paul Stebbing, Cefas

**Version:** Final (April 2016) – Drafted September 2011; signed off by NNRAP February 2012; approved by GB Programme Board March 2015; published on NNSS website September 2015.

## **Stage 1: Initiation**

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

A request is made for an assessment of an organism in the RA area

#### **Comments:**

Imports of American lobsters, *Homarus americanus* (H. Milne Edwards, 1837), into GB and other European countries for human consumption were made economically practical with the development of transatlantic jet aircraft (Alderman 1996). The fast reliable transportation of a valuable perishable cargo resulted in the establishment of a retail market in the United Kingdom. This allowed higher-valued European lobsters, *H. gammarus* (Linnaeus, 1758), to be exported to mainland Europe. Imported American lobsters would be kept in holding facilities near to coastal waters, and started to appear in the wild soon after. The first recorded case of an American lobster being found in UK waters was in 1988. Since then individual animals have occasionally been reported (14 between 1988 and 2009), but in 2010 a total of 13 animals were reported from GB (12 from England and one from Scotland). A further three have been reported from English waters in 2011. This has raised concerns over the possible impact that this species could have on native lobster stocks and potentially other decapod crustacea. It is thought that the species could potentially outcompete a number of economically important species, such as European lobster through direct competition and potentially interbreeding, but also the edible crab (*Cancer pagurus*). There is also the risk of the introduction of disease, such as Gaffkaemia, White Spot Syndrome Virus (WSSV) and Epizootic Shell Disease (ESD).

### **2 - What is the Risk Assessment Area?**

GB coastal waters

#### **Comments:**

Although *H. americanus* has predominantly been found off the south coast of England, there have been reports from elsewhere in GB (both recorded and anecdotal). Therefore all of GB is included in the risk assessment.

### **3 - What is the name of the organism? This will appear as a heading (Other names used for the organism can be entered in the comments box)**

The American lobster (*Homarus americanus*)

#### **Comments:**

The American lobster (*Homarus americanus*) sometimes called the Canadian lobster.

### **4 - What is the status of any earlier Risk Assessment?**

None exists

### **5 - Give details of any earlier Risk Assessment(s)**

## Stage 2a: Organism Risk Assessment

**6 - If you are sure that the organism clearly presents a risk, or that in any case a full Risk Assessment is required, you can omit this section and proceed directly to Section B.**

Continue with Organism Screening

### 7 - What is the taxonomic group of the organism?

*Homarus americanus* H. Milne Edwards, 1837

Comments:

- Kingdom: *Animalia*
- Phylum: *Arthropoda*
- Class: *Malacostraca*
- Order: *Decapoda*
- Superfamily: *Nephropoidea*
- Family: *Nephropidae*
- Genus: *Homarus*
- Species: *Homarus americanus*

### 8 - What is the taxonomic status of the organism?

Single taxonomic entity

There is some debate as to the reliability of taxonomic methods currently used in GB to correctly identify American lobsters due to the occasional occurrence of ventral spines on the rostrum of European lobsters and variations in colour. Molecular techniques have been used in Norway to distinguish between 'unusual' lobsters with spines and 'true' American lobsters (Jørstad *et al.* 2007; 2011). This technique eliminates false positives; 91 suspect American lobsters have been found in Norway between 2000 and 2011 with only 24 of these being confirmed as American lobster (Jørstad *et al.* 2011). However, the occurrence of sub-rostral spines is rare in GB waters (Addison & Bannister, 1994), with no suspect lobsters having been reported to date. It is therefore suspected that the ratio of 'unusual' lobsters may be lower in GB than that observed in Norway; molecular testing would be the only method of testing this theory. Several of the reported landings of *H. americanus* in 2010 were identified by the Natural History Museum, London using key morphological characters and deposited in the reference collection (NHM reg. 2010.1087), so material is available from some samples for molecular analysis if required.

### 9 - If not a single taxonomic entity, please give details?

### 10 - Is the organism in its present range known to be invasive?

Yes / possible (the organism is considered to be invasive)

Comments:

The native range of the American lobster is the north western Atlantic coast of North America and Canada. It has been reported in UK waters, predominantly in the south of England since 1988, with individuals being reported sporadically (14 between 1988 and 2009). However, in 2010 a total of 13 animals were reported from England (12) and Scotland (1). A further three have been reported from English waters in 2011. There may have also been additional finds elsewhere in GB that have not been reported, or not correctly identified that may alter these figures. These numbers are likely to have been under-estimated as fishermen may not be aware or notice the difference between the species, they may not know that they should report these findings, or they may not want to report these findings (for various reasons). Also the proportion of the numbers caught is likely to be considerably less than those released.

There is evidence to suggest that American lobsters are more aggressive than our native European lobster (*Homarus gammarus*). It is also believed that *H. americanus* could outcompete the native European lobster for resources such as food and shelter (van der Meeren *et al.* 2000 & 2008). There is also evidence to suggest that the two species could hybridise (Audouin & Leglise 1972; Hedgecock *et al.* 1977; Carlberg *et al.* 1978; Talbort *et al.* 1984). This has been observed in Norway where a female American lobster was caught from the wild carrying eggs and was taken into captivity; when the eggs finally hatched they were found to be European/American hybrids (pers. comm. Dr. A-L. Agnalt). Both of these could potentially impact on native lobster stocks.

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

Isolated distribution (but not under containment)

Comments:

It has been reported from the south and east coasts of England (from Cornwall to Suffolk) as well as the east coast of Scotland. Although reports are of relatively low numbers it is thought that not all of the landings have been reported so the distribution may be much broader than currently realised. There are several anecdotal reports of American lobsters being landed from all over GB, but these are difficult to report, clarify or confirm. The reports from 2010 are from relatively discreet geographical locations and the landings have occurred over short time periods, suggesting that the animals had been recently released. However the number caught are likely to be a fraction of the total numbers released.

American lobsters are imported into GB and held at a number of locations around the coast of GB. The full distribution of these holding facilities in England and Wales are not known.

## 13 - 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?

Yes / possible

Comments:

Environmental conditions around the coast of GB are similar to those of the species' native range and therefore it would seem likely for the species to be able to survive and reproduce in the risk assessment area. A 'berried' or ovigerous female was reported from GB waters in 1995. This may have been due to breeding in GB waters, and was unlikely to be as a result of egg-bearing females being imported into GB as they are protected in the United States and Canada. However, eggs could be extruded, or mating could occur, during transport (Jørstad *et al.* 2011). Female clawed lobsters are able to store sperm for a considerable period, so mating could have occurred prior to capture. The discovery of a berried American female lobster in Norway, which produced hybrid American/European lobsters, is clear evidence that interspecific mating does take place in the wild (A-L. Agnalt pers. comm.). In van der Meeren *et al.* (2008) it was shown that if provided with a choice, female *H. gammarus* would select conspecific males, even over a dominant *H. americanus* male. However, evidence would suggest that if a male conspecific was not available then hybridisation might occur in the wild. Hybridisation could potentially result in a significant reduction in recruitment of *H. gammarus* populations if the number of *H. americanus* in GB waters was allowed to increase. There have also been reports of animals being found that are significantly larger than those normally imported for human consumption, suggesting that there has been molting and growth, although this growth could have taken place in holding facilities. The report of berried female American lobsters from Norway that have been found to be carrying hybrid eggs would suggest that breeding can and does take place in European waters.

## 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 / possible

Comments:

The known geographical distribution of American lobsters includes ecoclimatic zones comparable with those found in GB, which could allow the organism to survive and thrive.

## 15 - Could the organism establish under protected conditions (such as glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment Area?

Yes / possible

Comments:

American lobsters are maintained in holding facilities throughout GB prior to human consumption. Whilst populations of American lobsters could not establish in these facilities, they are usually close to, and often discharge into natural waters in which populations of American lobsters could establish.

**16 - Has the organism established viable (reproducing) populations anywhere outside of its native range?**

No / possible

**Comments:**

American lobsters have been reported from the wild in a number of other European countries including Denmark, Ireland, Norway, Sweden (van der Meeren *et al.* 2010) and in Normandy, France in 2003 (International Council of the Exploration of the Sea (ICES) Reports of the Working Group on Introductions and Transfers of Marine Organisms 2001-2008). American lobsters have been deliberately introduced into a number of locations over the years, including the Pacific coast of American and Japan (Kittaka 1984) with the idea of stock enhancement (Nobanis: CABI, 2008), but with no success. One study conducted in France saw the release of 1,300 juvenile hybrids of European and American lobsters (Addison & Bannister, 1994). However, American lobsters have not been found to have established viable populations outside of its native range. Berried females have been found both in GB and Nordic waters (one found carrying hybrid eggs). This would suggest that breeding may have taken place as berried female American lobsters are not normally exported for human consumption. There is proof that American lobsters can form hybrids with native European lobsters as discussed earlier. However, given the sporadic nature of the landing of American lobsters, the limited geographical locations in which they have been found, and the nature of the animals (banded with little or no bio-fouling and of a similar size), it would seem unlikely that animals landed in GB to date are from a breeding population. It is more likely that the reported animals are from recent releases, but only a proportion of the total animals released may have been caught, while those not caught may go on to form established populations in the future. There is a suggestion that breeding populations may have formed off the coast of Norway given the large numbers of animals being found.

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

Yes / possible

**Comments:**

European lobsters do not appear to move significant distances. Smith *et al.* (2001) showed that 95% of animals used in a mark-recapture study moved on average <3.8 km over an 862 day period, with a maximum distance range of 45 km. In contrast, American lobsters have been shown to regularly migrate to deeper waters during colder periods. Campbell (1986) showed that 75% of animals used in a mark-recapture study moved <15 km, 7% moved >30 km and a maximum recorded movement of 322 km, suggesting that American lobsters have the potential to rapidly spread by natural means. Given the nature of the trade in American lobsters, where animals are imported then distributed to holding facilities, restaurants as well as private sales (for example to boat owners), then human activities will be the quickest form of dispersal.

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

Yes / possible

The species could cause economic loss and social harm by loss of native stocks, resulting in a loss of revenue in localised areas. Full details and explanations are provided elsewhere in the risk assessment.

**19 - If answers to questions in this section were 'yes' (even if some were only possibilities), then a full assessment is likely to be necessary. If some answers were 'no' then consider whether this negates the need for a full assessment or not.**

**Please give an appraisal of whether it is necessary to proceed with a full assessment and briefly give the key reasons in the comment box.**

Necessary to proceed with full assessment

**Comments:**

American lobsters potentially pose a significant risk to our native European lobster stocks through direct and indirect competition. Their establishment may also lead to the further spread of diseases, including Gaffkaemia, into GB lobster holding facilities and to the wild, resulting in economic loss for owners and the local economy. American lobsters may also carry other diseases currently unknown in Europe, such as ESD, potentially causing further losses of native species.

## Stage 2b: Pathways

### 20 - How many pathways are relevant to the potential entry of this organism?

For organisms which are already present in Great Britain, only complete the entry section for current active pathways of new entry.

Few

#### Comments:

The main route of introduction of American lobsters into GB is via imports from North America and Canada. American lobsters are moved between holding facilities and their final point of consumption which increases their potential routes of introduction into the wild. There is anecdotal evidence to suggest that passenger liners and other vessels have discarded American lobsters overboard as waste. In addition, individuals concerned with the death of lobsters not eaten in restaurants have been known to release them to the wild. Evidence also exists suggesting the American lobsters have escaped from holding facilities, and have been deliberately released by animal activists and by people unaware of the environmental consequences of releasing these animals after having purchased them for eating, but being unprepared to cook them.

### 21 - Please list relevant pathways through which the organism could enter (one per line).

Give details about specific origins and end points of the pathways (where possible) in the comment box.

Imports for human consumption directly into GB (pathway into GB).

Holding facilities, accidental release and discarding (entry into the wild); cross contamination with *H. gammarus* and spread of infection via escapes or infected effluent water.

Deliberate release, including discarding from boats, animal activists, good intentioned individuals (entry into the wild).

#### Comments:

Imports of American lobsters enter into GB from America and Canada via products border inspection posts (BIP). These are then picked up by the importer and transported to holding facilities prior to human consumption. Animals are sold onto other retail outlets and holding facilities by the original importer. Holding facilities can be found in a number of locations, including restaurants, markets, supermarkets, and purpose-built facilities. Holding facilities are found throughout GB, and are of varying quality. There is evidence to suggest that escapes have occurred from holding facilities that have not been maintained properly. It is also suspected that moribund animals which are discarded into coastal waters subsequently survive. There are also rumours that American lobsters have been discarded from cruise liners and pleasure craft as waste. There are reports of several incidences where American lobsters have been released deliberately, such as by animal activists or individuals who have been unprepared to cook the animals. Where there is market demand which cannot be met via sales of *H. gammarus*, internal movements for trade may occur where the trader is ignorant of statute (e.g. certification and the need for a licence to import), the risks of holding both species together in a tank system and appropriate disposal and effluent discharge.

### 22 - Please select the pathway:

Holding facilities, accidental release and discarding (entry into the wild)

#### Comments:

There are several incidences where holding facilities have been implicated in the release of American lobsters into the wild. This pathway has been chosen for further review as there is more information to base the risk assessment on. There are also clear mechanisms by which the potential risk posed by holding facilities could be reduced. While there is clear evidence that some lobsters have been released from holding facilities, either due to bad maintenance or disposal of excess or moribund animals into open waters, the closing of this particular pathway may only reduce, rather than stop, American lobsters being found in the wild, as there are other pathways by which they can still enter open waters. However, given that holding facilities will contain the vast majority of the American lobsters in GB at any one time, it is thought that the control of this pathway could significantly reduce the animals entering into GB waters.

### **Holding facilities, accidental release and discarding (entry into the wild)**

Begin pathway-related questions

### 23 - How likely is it that the organism is strongly associated with the pathway at the point(s) of origin?

Unlikely

Level of confidence: high

#### Comments:

Given the low number of American lobsters reported from GB waters in comparison to the quantities imported, the escape of animals from holding facilities would appear to occur infrequently. Several American lobsters found in 2010 had been near to or directly linked with existing holding facilities, giving a high level of confidence in the association. In Scotland there is little evidence that the animal escaped from a tank facility or was recruited from the wild; it was more likely to have resulted from an inadvertent release.



**24 - How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin?**

Very unlikely

Level of confidence: high

Comments:

In 2010 approximately 260 tons of American lobsters were imported into GB (information from the SAGB). Although there has been a significant increase in the number of American lobsters found in GB waters reported in 2010, this is still a very small proportion of the total number of live animals entering into GB. Although it is very likely that there are several animals that have not been reported or incorrectly identified, it would seem unlikely that this would result in a significant increase in current figures. However, a gradual build up of animals in the wild from this and other pathways may result in the establishment of breeding populations given time. Also as trade increases, so will the risk.

**25 - How likely is the organism to survive during passage along the pathway?**

Likely

Level of confidence: high

Comments:

It would seem likely that the animals can survive the pathway from holding facility to open water. Although there are occasional mortalities in holding facilities the vast majority of animals do survive. Animals could either escape from holding facilities, or be discarded either as excess stock or because they are moribund or damaged. It would be less likely for the moribund or damaged animals to survive, although they would pose a risk of transmission of disease to naïve native lobster populations.

**26 - How likely is the organism to enter Great Britain undetected?**

Very unlikely

Level of confidence: high

Comments:

It would seem unlikely that American lobsters would enter into GB without detection. There is no reason for people to smuggle the animals in either from a third country or from another European Member State. However, it may be possible for animals to cross the English Channel by themselves if they have escaped from a French holding facility. It is likely that fishermen would report any increased presence of American lobsters in wild catches, this has not happened to date.

**27 - How likely is the organism to multiply/increase in prevalence during transport /storage?**

Very unlikely

Level of confidence: very high

Comments:

American lobsters would not breed and reproduce during transport or in the holding facilities that they are maintained in prior to human consumption and berried females are excluded from sale. Berried females are unlikely to be imported into GB as they are protected in the United States and Canada. However, eggs could be extruded, or mating could occur during transport (Jørstad *et al.* 2011). Female clawed lobsters are able to store sperm for a considerable period, so mating could have occurred prior to capture.

**28 - How likely is the organism to survive existing management practices within the pathway (answer N/A for intentional introductions)?**

N/A

Level of confidence: very high

Comments:

Holding facilities are set up for the purpose of keeping imported animals alive until they are sold for human consumption. Although the conditions are stressful and mortalities do occur, the majority of animals do survive. An exception would be transportation of diseased or infected animals, introduced to stressful conditions and dying. If associated with European lobsters the likelihood is that the disease would spread to other stocks within the system.

**29 - How likely is the organism to arrive during the months of the year most appropriate for establishment (if intentional introduction answer N/A)?**

Very likely

Level of confidence: very high

Comments:

American lobsters are imported into GB on a weekly basis and are held all year round. Therefore the accidental (or deliberate) introduction of these animals into GB waters could happen at any time of the year. Given that GB water temperatures are within the tolerance limit of American lobsters all year round then establishment could occur at any time.

**30 - How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?**

Unlikely

Level of confidence: low

Comments:

It is difficult to comment on how likely American lobsters are to be released or escape from holding facilities, due to the inaccuracy of recorded numbers. If reports of American lobsters are used as an indicator of how often the pathway may breakdown, then a very small proportion of the total number of imported American lobsters transfer from holding facilities to the wild. However, there is clear evidence to link holding facilities with the release of American lobsters into the wild.

end pathway-related questions

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**31 - Do other pathways need to be considered?**

No. However, the disposal of mortalities, moribund animals and those not due to be consumed is another pathway that could result in the transfer of disease to native stocks.

**32 - Please estimate the overall likelihood of entry into the Risk Assessment Area for this organism (please comment on the key issues that lead to this conclusion).**

Likely

Level of confidence: medium

Comments:

Collected data relating to the findings of American lobsters from UK waters would suggest that relatively low numbers of animals have found their way into open waters from holding facilities. However, it can be assumed that more animals are released or escape than are caught. The steady build up of numbers in open waters may result in the establishment of breeding populations over time.

## Establishment

### 33 - How likely is it that the organism will be able to establish in Great Britain based on the similarity between climatic conditions in Great Britain and the area of the organism's current distribution?

Very likely

Level of confidence: medium

Comments:

The east coast of America and GB share similar climates. If sufficient numbers of American lobsters were to enter GB waters then it is likely that populations would establish. As trade increases so does the risk, which makes it important to identify and mitigate those risks to minimise the likelihood of establishment.

### 34 - How likely is it that the organism will be able to establish in Great Britain based on the similarity between other abiotic conditions in Great Britain and the area of current distribution to be similar?

Very likely

Level of confidence: medium

Comments:

The similarity between the east coast of America and GB waters would make establishment very likely.

### 35 - How many species or suitable habitats vital for the survival, development and multiplication of the organism species are present in Great Britain? Please specify in the comment box the species or habitats.

Many

Level of confidence: high

Comments:

American lobsters share very similar habitat preferences with our native European lobsters. It would therefore seem likely that American lobsters will establish in areas where European lobsters are currently found. This is supported by the fact that the reported findings of American lobsters have been made by lobster fishermen catching European lobsters.

There are no specific species required by American lobsters for their establishment beyond the requirements of our native European lobster.

### 36 - How widespread are the species or suitable habitats necessary for the survival, development and multiplication of the organism in Great Britain?

Widespread

Level of confidence: high

Comments:

European lobsters can be found around much of the coast of GB, and therefore habitat suitable for the survival of American lobsters is present around much of GB.

### 37 - 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 Great Britain?

N/A

Level of confidence: very high

### 38 - How likely is it that establishment will occur despite competition from existing species in Great Britain?

Likely

Level of confidence: medium

Comments:

It has been reported that the American lobster is more aggressive than the native European lobster and would therefore out compete them for resources (van der Meeren *et al.* 2000). This aggression has also been observed in hybrid animals. It would therefore seem likely that populations would become established despite competition from native species.

### 39 - How likely is it that establishment will occur despite predators, parasites or pathogens already present in Great Britain?

Very likely

Level of confidence: high

Comments:

American and European lobsters are very similar species, so it would seem likely that their tolerance to parasites and pathogens are also similar (*Gaffkaemia* illustrates this). American lobsters in UK waters would therefore be exposed to the same parasites and pathogens as the European lobster and cope with them in a similar manner. It would also be likely that the American lobster will be targeted by the same predators as the native lobster. It can therefore be assumed that the American lobster will be able to survive in the same areas as European lobsters as it is likely that the same limiting factors will affect both species in a similar manner.

#### 40 - How likely are management practices in Great Britain to favour establishment?

Unlikely

Level of confidence: medium

Comments:

The Lobster (Control of Deposit) Order was put into place in 1981 to try and control *Gaffkaemia* being brought into GB with imports of American lobsters. The Order puts licence conditions on facilities holding American lobsters so that the species are held in such a way that *Gaffkaemia* will not be released from the premises. As a benefit of these controls, the potential release of American lobsters is also controlled. Since the introduction of the Order it has been realised that *Gaffkaemia* is not an issue in wild stocks, but is a problem in holding facilities. Because of this, and other increasing aquatic animal disease issues, the Order has not been implemented as rigorously as it previously was. This has resulted in the reduction in the standard of holding facilities, with some holding facilities not being licensed under the Order. With the decrease in disease controls on holding facilities there has also been an indirect reduction on the control of American lobsters as a non-native species. This has resulted in an increase in the number of animals escaping from facilities, as the facilities are no longer operating under such rigorous licensed conditions. If the Lobster Order was re-implemented from a non-native species perspective then this may reduce the number of American lobsters found in GB waters. It should be noted that under Section 14 of the Wildlife and Countryside Act 1981 the release of non-native species is prohibited.

#### 41 - How likely is the organism to establish despite existing management practices in Great Britain?

Likely

Level of confidence: medium

Comments:

Despite commercial catching of American lobsters keeping their numbers down, it is likely that only a small proportion of the American lobsters released into UK waters are subsequently removed in this manner. However, there is evidence to suggest that American lobsters have not established in UK waters yet. If this had happened it would be expected for an increasing number of animals of varying sizes to be found over an expanding geographical region. At this point it would be expected that fishermen would report a decrease in European lobster catches with the presence of American lobsters in catches, corroborating the theory that American lobsters would outcompete European lobster. Also if the Lobster Control of Deposit Order/Wildlife and Countryside Act were implemented more rigorously, then this would reduce the introduction of more animals into the wild.

#### 42 - How likely is it that biological properties of the organism would allow it to survive eradication campaigns in Great Britain?

Moderately likely

Level of confidence: medium

Comments:

Eradication programmes in the marine environment are notoriously difficult to implement. However, in the same way that many crustacean fisheries can be fished to the point of extinction, requiring the implementation of management strategies, it would seem possible for American lobsters to be trapped equally rigorously.

#### 43 - Is establishment likely to be aided by the biological characteristics of the organism?

Likely

Level of confidence: high

Comments:

Yes, it is a robust species that is more aggressive than our native lobster, which is likely to be displaced.

#### 44 - Is the organism's capacity to spread likely to aid establishment?

Moderately likely

Level of confidence: medium

Comments:

Given the mobile and migratory nature of American lobsters and the amount of suitable habitat available to them in

GB, then this would aid in establishment.

**45 - How likely is the adaptability of the organism to aid its establishment?**

Likely

Level of confidence: medium

Comments:

It is not known how adaptable the species is to changing conditions and how this may aid its ability to become established. However, it is found over a broad geographical range, which suggests that it can adapt to a variety of environmental conditions.

**46 - How likely is it that the organism could establish despite low genetic diversity in the founder population?**

Likely

Level of confidence: low

Comments:

How likely establishment is with low genetic diversity is not known. However, it is believed that Norway may have populations of American lobsters forming off their coast, which have entered through the same pathways as lobsters into GB (i.e. through importers with subsequent escapes from holding facilities). Assuming that genetic diversity of stock entering both Norway and GB would be the same, then it would seem likely that it would be sufficient to allow the establishment of wild populations.

**47 - How likely is the organism to be established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Great Britain?**

(Note that home gardens are not considered protected conditions in this sense.)

Very unlikely

Level of confidence: medium

Comments:

American lobster would not establish in holding facilities.

**48 - Based on the history of invasion by this organism elsewhere, how likely is it to establish in Great Britain? (If possible, specify the instances of invasion in the comments box.)**

Moderately likely

Level of confidence: medium

Comments:

American lobsters have not invaded elsewhere, but are found with increasing regularity in Norwegian waters, and it is thought that populations of American lobsters may be forming. There has not been the same level of controls placed on the holding of American lobsters in Norway as in GB, which may have resulted in greater numbers escaping. The current case in Norway may be an indicator of what may happen in GB if numbers are allowed to increase.

**49 - If the organism does not establish, then how likely is it that transient populations will continue to occur?**

Likely

Level of confidence: high

Comments:

American lobsters have been reported from UK waters since 1988. It would therefore seem unlikely for this to stop unless there is a change in management strategy. Recent data would suggest that these numbers are increasing, with possible transient populations leading to further establishment. This is likely to increase with the development of trade.

**50 - Please estimate the overall likelihood of establishment (mention any key issues in the comment box)**

Likely

Level of confidence: medium

Comments:

Establishment seems likely if measures are not taken. Although it may take several years for numbers to build up to sufficient levels for noticeable populations to form, the continual introduction of small numbers of animals from the pathways discussed will facilitate this process.

## Spread

### 51 - How rapidly is the organism liable to spread in Great Britain by natural means?

Slowly

Level of confidence: medium

Comments:

In their natural range American lobsters migrate to deeper waters during winter months and therefore travel, on average, much greater distances than European lobsters. Although they have a greater capacity to spread than native lobster, the process will still be slow.

### 52 - How rapidly is the organism liable to spread in Great Britain by human assistance?

Rapidly

Level of confidence: very high

Comments:

American lobsters are held throughout GB. Although they enter the risk assessment area through a limited number of routes they are rapidly dispersed by humans.

### 53 - Within Great Britain, how difficult would it be to contain the organism?

Easy, with focussed controls

Level of confidence: medium

Comments:

The more rigorous implementation of statute, such as the Lobster Control of Deposit Order and the Wildlife and Countryside Act, may be an effective manner by which the animals can be contained. However, this would still not negate other pathways which may be difficult to legislate against, but an awareness raising programme may prevent some deliberate releases by well-intentioned individuals or ill-informed traders.

### 54 - Based on the answers to questions on the potential for establishment and spread in Great Britain, define the area endangered by the organism.

Marine coastal regions, especially in areas where there are existing European lobster populations. There is also an unquantifiable risk from establishments holding lobsters, where animals and their products may be disposed of inappropriately into the sea.

### 55 - Please estimate overall potential for spread (using the comment box to indicate any key issues).

Moderately

Level of confidence: medium

Comments:

Given the human involvement with the movement of American lobsters between holding facilities, markets and restaurants based all over the risk assessment area, in addition to their own dispersal, it would seem likely that they would disperse rapidly throughout the country. However, populations may take some time to develop given their low breeding success rate.

## Impact

### 56 - How great is the economic loss caused by the organism within its existing geographic range, including the cost of any current management?

Minor

Level of confidence: medium

Comments:

It is very difficult to determine the economic loss caused by any aquatic invasive species, especially when the biological impact that the species is having is not fully understood. The economic loss caused by the physical presence of American lobsters in GB waters is likely to be minimal at the moment, though potentially elevating to major/massive if the impact on the native lobster fishery is extensive (for example through direct competition, disease and out breeding by hybridisation). If Gaffkaemia, a disease which was introduced with American lobsters, is included in the calculations, then in certain instances a whole holding facility can be wiped out at a time. In GB this may occur twice per year (on average the number of incidences of loss that get reported). This can be estimated as a minimal/minor loss per annum. If the losses caused by Gaffkaemia since its original introduction into GB were looked at, then the losses are likely to be major. Management strategies that are implemented to try and prevent losses caused by Gaffkaemia in holding facilities would likely be major. There are currently no management programmes in place to control American lobsters, apart from the requirement for licensed introductions and prohibition of release within the Wildlife and Countryside Act.

### 57 - How great a loss of production is the organism likely to cause in Great Britain? For example, how serious is the direct negative economic effect of the organism likely to be on crop yield and/or quality, livestock or fish health and production? (Describe the nature and extent of expected losses in the comment box.)

Moderate

Level of confidence: medium

Comments:

It is difficult to estimate the current effect of American lobsters on European lobster stocks (the most likely high yield crop that American lobsters will impact). The current impact is likely to be minimal, but if breeding populations of American lobsters were to become established then it is likely that the whole fishery would be affected, with major/massive economic loss. For example, if GB lobster fishery was to be lost then it would cost GB PLC £26.5m. Other losses of similar fisheries (e.g. edible crab) would also be of significant cost.

American lobsters will most likely have an impact on native lobsters first and foremost due to the overlap in niche use. The impact of American lobsters is likely to be broader than this as it has a greater niche range in its natural range. Other decapods, such as edible crabs, do inhabit niches that overlap with those potentially inhabited by American lobsters, so there may be some impact. However, how a non-indigenous species behaves outside of its natural range is not always predictable due to the release and/or changes in pressures, the state of the population and environmental differences.

### 58 - How great are the additional economic costs associated with managing this organism likely to be?

Minor

Level of confidence: medium

Comments:

The economic cost for potential pathways management e.g. re-establishment of the Lobster Control of Deposit Order, in addition to an awareness-raising campaign, inspection of holding facilities and possibly a reward process for those reporting American lobsters, would be of minor/moderate cost.

### 59 - How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment Area?

Minimal

Level of confidence: medium

Comments:

The vast majority of native crustaceans are exported to mainland Europe. If there was a loss of yield from our lobster stocks due to the impact of American lobsters then demand may decrease. However, the demand for American lobsters is unlikely to change long-term.

### 60 - How significant might the losses in export markets be due to the presence of the organism in the Risk

### Assessment Area?

Minimal

Level of confidence: medium

Comments:

The loss of current exports (due to the presence of American lobsters) is minimal; any current losses are mainly due to the effects of Gaffkaemia on stocks of native lobsters in holding facilities. It is not clear exactly how many holding facilities there are in GB, although it is estimated that there are approximately 50 located within 1 mile of tidal waters in England and Wales.

The losses caused by the presence of American lobsters in the wild is currently difficult to assess, but is likely to be minimal. However, if breeding populations were to establish then the impact could increase to 'major/massive', if the whole European lobster fishery was affected. The impact that American lobsters may have on other exports (e.g. edible crab) is not known.

### 61 - How important might other economic costs be resulting from introduction of the organism? (Specify in the comment box)

Minimal

Level of confidence: medium

Comments:

This is difficult to assess as the effects that American lobsters may have on other economically valuable species is unknown. However, the loss of lobster fisheries in the long-term could have significant impact on isolated fishing communities. The costs of control and eradication attempts would add to the burden.

### 62 - How important is environmental harm caused by the organism within its existing geographic range under any current management regime?

Medium to high risk

Level of confidence: medium

Comments:

It is very difficult to assess the environmental harm caused by American lobsters, without further work. As the lobster Control of Deposit Order is not being implemented to its full extent, there is currently no management regime, other than an ad-hoc removal of the animals from the wild.

Although the information on environmental damage is limited there is evidence to suggest that American lobsters are more aggressive than our native European lobster (*Homarus gammarus*). It is also believed that *H. americanus* could outcompete the native European lobster for resources, such as food and shelter (van der Meeren *et al.* 2000 & 2008). It has been suggested that the two species could hybridise (Audouin & Leglise 1972; Hedgecock *et al.* 1977; Carlberg *et al.* 1978; Talbot *et al.* 1984). This has been observed in Norway where a female American lobster was caught from the wild carrying eggs and was taken into captivity. When the eggs finally hatched they were found to be European/American hybrids (pers. comm. Dr. A-L. Agnalt). How these would impact on native lobster stocks is not fully understood. It is also possible that American lobsters would impact on other species of environmental and economic value such as the edible crab (*Cancer pagurus*) through competition. The full extent of the species distribution is not fully understood due to a lack of accurate reporting/surveying; therefore the existing geographical range of the species is not fully understood.

### 63 - How important is environmental harm likely to be in Great Britain taking into account any management interventions that might be implemented?

Medium

Level of confidence: medium

Comments:

With the implementation of a robust survey programme the severity of the situation can be more clearly realised. This will help to assess the most appropriate action to take. However, the simple measure of regulating the holding of American lobsters by further implementation of the Lobster Control of Deposit Order would possibly reduce the number of animals entering the wild significantly, thus reducing the potential for breeding populations to form. These measures along with the continued removal of American lobsters could lead to effective control of the issue and remove any significant environmental harm.

### 64 - How important is social, health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range under any current management regime?



Minor

Level of confidence: low

Comments:

Currently the social impact of American lobsters is likely to be minimal, but concern has been raised by lobster fisherman and the Shellfish Association of Great Britain (SAGB) on the potential long-term impact that this species may have on European lobster fisheries, and the subsequent socio-economic impact.

**65 - How important is the social, health or other harm likely to be in Great Britain taking into account any management interventions that might be implemented?**

Minimal

Level of confidence: medium

Comments:

Whilst the more rigorous implementation of statute, the Lobster Control of Deposit Order/Wildlife and Countryside Act, would increase the burden on those holding American lobsters, it could radically reduce the risk posed by holding facilities. There may also be further benefits in the closer monitoring of decapod holding facilities as far as disease and other non-native species are concerned, as this sector of the industry is currently un-regulated.

**66 - How important is it that genetic traits of the organism could be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?**

Major

Level of confidence: low/medium

Comments:

American lobsters have formed hybrids with European lobsters in Norway. It is still unclear as to how this may affect a fishery and if the hybrids are fertile or not, but it is recognised that hybrids are more aggressive, so in theory more capable of competing with native stock. There was a mass (1,300) release of hybrids into French waters (Addison & Bannister, 1994), but there have been no reports of any marked impact on native stock, although a lack of reports on the subject does not translate into 'no impact'.

**67 - How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens, that may already be present in Great Britain?**

Major

Level of confidence: medium

Comments:

The impact on the native European lobster fishery could be significant in a worst case scenario (major to massive given the value of the fishery of £26.5m), if breeding populations of American lobsters were to form and displace/disrupt the native stocks. This may be a localised effect initially, with the effect expanding with further spread of the species. However, it may be likely that populations of American lobsters could also be exploited, possibly offsetting any economic impact to some extent.

**68 - How difficult is it likely to be to control the organism in Great Britain?**

Easy

Level of confidence: medium

Comments:

As discussed, the further implementation of controls, e.g. the Lobster Control of Deposit Order could reduce the risk posed by holding facilities, but this would not close all pathways. An awareness raising campaign and routine passive inspection of holding facilities could help reduce the risk of other pathways. A reward system for American lobsters caught from the wild, could work in principle, but may be difficult to police and is open to abuse. A combined system of closing pathways and removing any animals found could result in an effective control programme. Given that there is really only one route of introduction into GB (i.e. import trade), more rigorous control of this pathway will greatly assist in reducing introductions into the wild.

**69 - How likely are control measures introduced for this new organism to disrupt existing biological or integrated systems used to control other organisms in Great Britain?**

Very unlikely

Level of confidence: high

Comments:

It is unlikely that the control measures suggested would disrupt existing systems. They would increase awareness and

standards.

**70 - How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?**

Likely

Level of confidence: medium

Comments:

It should be noted that there is generally a lack of understanding of disease in decapod crustaceans, and especially in lobsters (Shields *et al.* 2006). However, American lobsters have already resulted in the introduction of Gaffkaemia (Kellog *et al.* 1974) and the introduction of the Lobster Control of Deposit Order (Alderman 1996), which has also had significant impact in Norway (Wiik *et al.* 1987). Epizootic Shell Disease (ESD) is having a significant impact on American lobsters in their native range (Stevens 2009), resulting in the closure of a major fishery. ESD has been found in Norway on American lobsters from the wild. It is not known if native lobsters are susceptible to ESD, but it could have a significant impact if they were. It is likely that American lobsters may carry other pathogens that we are currently not aware of. This would make establishment more likely if the American lobsters were to introduce a disease to which they were immune and to which native lobster and/or other species were susceptible (in a similar manner as crayfish in GB). White Spot Disease or White Spot Syndrome Virus (which is listed in 2006/88EC), could also be introduced with the importation of American lobsters entering GB as a food item, and potentially finding its way into the wild through the pathway described. The water in which American lobsters are transported could also pose a significant risk if it is not disposed of in an appropriate manner.

**71 - Indicate any parts of Great Britain where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible).**

South coast of England

Comments:

Given that the south coast of GB is where the vast majority of American lobsters have been found to date, it would seem likely that the lobster fisheries in this area are affected primarily. However, given that there is evidence to suggest that American lobsters have been found from a number of other locations it may be possible that all of GB would eventually be affected. In many coastal areas of Scotland, particularly in remote rural locations, creeling for lobsters is an important fishery of high value and if controls are not improved there could be ever increasing and significant impacts across a wide area.

**72 - Overall impact rating (please comment on the main reasons for this rating).**

Major

Level of confidence: medium

Comments:

There are several key points to take into account when considering the overall impact that American lobsters may have. American lobsters have not currently established in GB, so the current overall impact rating is likely to be minimal. However, if populations were to form then the overall impact rating would be significantly higher. Given the main impacts would be on GB lobster fishery (currently costed at £26.5m per annum), then the impact would be major/massive. The main points by which American lobsters would have an impact if populations were to form are:

1. The American lobster may outcompete the European lobster for resources. This may result in a reduction in numbers of European lobsters as the lack of resources impacts on recruitment. This could have significant effects if current fishing pressures for European lobsters were maintained. Disease could enhance the potential of the invasive species to establish due to a certain resistance to the disease. The result would be catastrophic for the native populations.
2. The American lobster may form hybrids with European lobsters. This may also reduce recruitment of European lobsters. It is not known if offspring from a heterospecific pairing are viable or how competitive they may be in comparison to European lobsters.
3. American lobsters could impact on other environmentally or commercially important species that share a similar habitat e.g. edible crab.
4. The introduction of American lobsters into UK waters may transfer disease such as ESD, which may transmit to European lobsters causing significant mortalities.
5. The collapse of the European lobster fishery as a result of American lobsters would have significant effects on our fishing industry and export market, particularly in remote rural locations.

**Overall**

**73 - Give an overall assessment of the risk, taking into account the likelihood of entry and establishment, the**

expected level of spread, and the potential impact.

Major

Level of confidence: medium

## References

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

- Addison JT, Bannister RCA (1994) Re-stocking and enhancement of clawed lobster stocks: a review. *Crustaceana* 67(2): 131-155.
- Alderman DJ (1996) Geographical spread of bacterial and fungal diseases of crustaceans. *Scientific and Technical Reviews, Office of International Epizootics* 15: 603–632.
- Audouin J, Leglise M (1972) Premiers resultats d'expériences relatives aux possibilités d'acclimatation de homard américain *Homarus americanus* en France. *ICES Comm Meet E*: 34:1-3.
- CABI, 2008. *Homarus americanus* (American lobster). In: *Invasive Species Compendium*, net-version (<http://www.cabi.org/isc/>). Wallingford, UK.
- Campbell, A (1986) Migratory movement of ovigerous lobsters, *Homarus americanus*, tagged off Grand Manan, eastern Canada. *Canadian Journal of Fisheries and Aquatic Science*. 43: 2197- 2205.
- Carlberg JM, Van Olst JC, Ford RF (1978) A comparison of larval and juvenile stages of the lobsters, *Homarus americanus*, *Homarus gammarus* and their hybrid. *Proceedings of the World Mariculture Society* 9:109-122.
- Hedgecock D, Nelson K, Simons J, Shleser R (1977) Genic similarity of American and European species of the lobster *Homarus*. *Biological Bulletin* 152:41-50.
- Jørstad KE, Agnalt A-L, Farestveit E (2011) The introduced American lobster, *Homarus americanus* H. Milne Edwards, 1837 in Scandinavian waters In: Galil BS, Clark PF, Carlton JT (eds) *In the wrong place: alien marine crustaceans – distribution, biology and impacts*. Springer series in Invasion Ecology. Springer-Verlag, Dordrecht (in press).
- Jørstad KE, Prodohl PA, Agnalt A-L, Hughes M, Farestveit E, Ferguson AF (2007) Comparison of genetic and morphological methods to detect the presence of American lobsters, *Homarus americanus* H. Milne Edwards, 1837 (Astacidae: Nephropidae) in Norwegian waters. pp. 103–113. In: Cook EJ, Clark PF (eds.) *Invasive Crustacea. Symposium 7 at the Sixth International Crustacean Congress (ICC6)*, held at the University of Glasgow, UK, 18–22 July 2005. *Hydrobiologia* 590: 1–121.
- Kellog S, Steenbergen JF, Scharpio HC (1974) Isolation of *Pediococcus homari* etiological agent of Gaffkemia in lobsters from a California estuary. *Aquaculture* 3:409-413.
- Kittaka J (1984) Ecological survey of lobster *Homarus* along the coasts of the Atlantic Ocean. Ecology and distribution of *Homarus capensis* along the South Atlantic Ocean. *Report to the Ministry of Education, Culture and Science (Overseas Scientific Survey No. 56042009, 57041052 and 58043052)*, (1984), p. 118.
- Linnaeus C (1758) *Systema Naturae per Regna Tria Naturae, Secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis Synonymis, Locis*. Edition 10. Holmiae. I: iii + 1–824.
- Milne Edwards H (1837) *Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux*. Paris, Librairie de Roret. II: 1–532.
- NOBANIS. <http://www.nobanis.org/Marineldkey/Crabs%20and%20lobsters/HomarusSpp.htm>
- Smith, IP, Jensen, AC, Collins, KJ, Matthey EL (2001) Movement of wild European lobsters *Homarus gammarus* in natural habitat. *Marine Ecology Progress Series* 222: 177-186.
- Shields JD, Stephens FJ, Jones B (2006) Pathogens, Parasites and other Symbionts. In: Philips B, (ed.) *Lobsters: Biology, Management, Aquaculture and Fisheries*. Blackwell Publishing pp 146 – 204.
- Stevens BG (2009) Effects of epizootic shell disease in American lobsters *Homarus americanus* determined using a quantitative disease index. *Disease of Aquatic Organisms* 88: 25-34.
- Stewart JE, Cornick JW, Spears DI (1966) Incidence of *Gaffkya homari* in natural lobster (*Homarus americanus*) populations of the Atlantic Region of Canada. *Fisheries Research Board of Canada* 23(9): 1325-1330.
- van der Meeren GI, Chandrapavan A, Breithaupt T (2008) Sexual and aggressive interactions in a mixed species group of lobsters *Homarus gammarus* and *H. americanus*. *Aquatic Biology* 2: 191-200.
- van der Meeren, GI, Ekel, KO, Jørstad KE, Tveite S (2000) Americans on the wrong side- the lobster *Homarus americanus* in Norwegian waters. *ICES CM* 2000/U: 20:1-15.
- Wiik R, Egidius E, Goksøyr J (1987) Screening of Norwegian lobsters *Homarus gammarus* for the lobster pathogen *Aerococcus viridians*. *Disease of Aquatic Organisms* 3: 97-100.