

Dungeness crab (*Metacarcinus magister*)



- Marine crab from the Pacific Northwest.
- Several hundred individuals were deliberately released near Brighton in June 2015.
- Not known to be established outside of its native range but could potentially impact on native species including commercially viable brown crab.

History in GB

In June 2015, up to several hundred Dungeness crabs were deliberately released in the eastern English Channel near Brighton. It is likely that they have dispersed to some extent since. Live imported specimens are held temporarily in secure tanks at various seafood merchant premises within GB, annual imports are a few tonnes per year. As climatic conditions in its native range have similarities to those in the risk assessment area, this species could potentially survive and reproduce throughout coastal waters off GB.

Native distribution

Native to nearshore waters of the Pacific Northeast.
(Native range in red)



Source: University of Wisconsin-La Crosse 2017

Distribution in GB



Impacts

No self-sustaining populations have been found anywhere outside of their native range making impact in GB difficult to predict, but potential impacts may include:

Environmental

- Introduction of diseases which affect native crustaceans.
- Displacement of native species, including the European shore crab *Carcinus maenas*.
- Predation on native fauna.

Economic

- Problems for brown crab *Cancer pagarus* fisheries as Dungeness crab may impact on this species.

Social

- None known.

Introduction pathways

Food trade - potential for further escapes from seafood merchants or release of animals purchased by members of the public. It is likely that most imported specimens are male as commercial fisheries in their native range are only permitted to land males.

Spread pathways

Natural - adults and juveniles move by walking and may be able to move a kilometre or two per day. An introduction of adult males may potentially spread up to 100km from their release point over a year.
Human aided - planktonic stages may be transported in ballast water. Juveniles and possibly adults may be spread on the hulls of ships or through movements of aquaculture stocks.

Summary

	Risk	Confidence
Entry	MEDIUM	MEDIUM
Establishment	UNLIKELY	MEDIUM
Spread	INTERMEDIATE	LOW
Impacts	MODERATE	LOW
Conclusion	LOW	LOW

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

Rapid Risk Assessment of: Dungeness crab, *Metacarcinus magister*

Author: Alastair Cook & Paul Stebbing (Cefas)

Suggestion citation: Cook, A. and Stebbing, P. (2015). GB Non-native Organism Rapid Risk Assessment for Dungeness crab, *Metacarcinus magister*. www.nonnativespecies.org

Draft: Draft 1 (30/06/15)

Signed off by NNRAP: November 2016

Approved by Programme Board: February 2017

Placed on NNSS website: April 2017

GB Non-native species Rapid Risk Assessment (NRR)

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.

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

Response: To rapidly assess the threat posed by the Dungeness crab, *Metacarcinus magister*, following its suspected release into GB waters.

2 - What is the Risk Assessment Area?

Response: Great Britain (i.e. England, Scotland and Wales)

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

Response: *Metacarcinus magister*, *Cancer magister*, Dungeness crab.

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

Response: No. There are only three other substantiated reports of capture of this species from outside of its native range. Two of these were in Japan (Abe, 1981; Komai et al, 1992) and one was in the Gulf of Maine (<http://news.mit.edu/2006/crab>). Self-sustaining populations have not resulted from any of these releases.

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

Response: Live imported specimens are held temporarily in secure tanks at various seafood merchant premises within GB, although the locations of these establishments are uncertain. They may be sold live to members of the public. Imports to GB are thought to total only a few tonnes per year, and it is believed that there are only two GB importers. Whether there is any seasonality to this trade is uncertain, and exact holding/distribution practices within the UK are uncertain.

Up to several hundred Dungeness crabs were deliberately released between 2 and 4 km offshore in the Eastern English Channel near Brighton on 15th June 2015. It is likely that they have dispersed to some extent since. These were all adult animals, as they must have been purchased from a shellfish merchant and therefore imported from commercial fisheries in their native range.

As commercial fisheries in their native range are only permitted to land adult males of the species, it is likely that most, if not all, of the released animals (and those held/sold by seafood merchants) are male. The two sexes can be easily distinguished via a cursory examination by the shape of their abdomen. A small number of recaptures from the release area at Brighton were examined and all were found to be male (Cefas FHI, pers. comm.).

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: Its native range is nearshore waters of the Pacific Northeast, from the Aleutian Islands (Alaska) to Point Conception (California). It is a generalist carnivore. It inhabits areas with sandy or muddy substrates from the low intertidal to depths of at least 230m, and is commonly found in eel grass beds. It can tolerate temperatures of up to about 25°C, but may suffer increased mortalities over 17°C (Pauley et al., 1989). It is therefore concluded that the species could survive and reproduce throughout coastal waters off Great Britain.

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 (see above)

8 - Has the organism established viable (reproducing) populations anywhere outside of its native range (do not answer this question if you have answered 'yes' to question 4)?

Response: Whilst there are reports of captures of this species in Atlantic fisheries (e.g. <http://www.livescience.com/7143-pacific-crab-invades-atlantic.html>) no reports of the establishment of viable populations outside of its native range were found during a literature search.

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

Response: There are insurmountable natural barriers which preclude the spread of Dungeness crabs from their native range into Great Britain without human assistance. International trade in live crabs for human consumption represents the most likely route of introduction, although all commercial catches from their native range should consist only of male specimens. It is also possible that larvae and juveniles may be introduced via ballast water.

Juvenile and adult crabs are motile (through walking only) so are likely to be capable of finding suitable habitat following an introduction. Adults undertake intertidal migrations (Holsman et al. 2006) where they can travel up to 1.2km between tides. Therefore their dispersal potential could be as high as 2.4+ km per day based on these observations. The larval stage is planktonic for a period of 3-4 months during the late winter/spring/summer depending on latitude (Zhang and Dunham, 2013). They can therefore potentially disperse over large distances at this life stage and potentially cross 'barriers' which adults may not be able to.

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

Response: As a generalist benthic predator/scavenger, the species has the potential to cause ecological changes through competition with native crustacean populations including commercially exploited brown crab (*Cancer pagurus*) and velvet swimming crab (*Necora puber*), predation on native fauna and the introduction of disease. It has been suggested that this species limits the spread of the European shore crab (*Carcinus maenas*) where it has been introduced along the west coast of America. There is, however, considerable uncertainty about how they would interact with native ecosystems in Great Britain. Any changes they may cause could result in economic harm associated with reduced fishery revenue, and in the event of establishment may become a lucrative fishery in their own right. There is the possibility that Dungeness crabs may hybridise with native species, although there are few cases recorded of this occurring in the wild, and most cases of hybridisation in decapod Crustacea refer to native males mating with non-native females rather than vice versa. Dungeness crabs are likely to be susceptible to White spot syndrome virus (WSSV), although environmental conditions in North America are not conducive to the occurrence of this disease. The scientific literature indicates that a number of parasites have been reported from Dungeness crab (such as Hematodinium and microsporidia, and chlamydia-like agents). The disease profile of the species may pose the greatest risk especially as there is so little known.

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).

[Delete accordingly]

Response: *very unlikely* / *unlikely* / **moderately likely** / *likely* / *very likely*

Confidence: *very low* / *low* / **moderate** / *high* / *very high*

Comments (include list of entry pathways in your comments): Given the MMOs intelligence on the release off Brighton, and the subsequent recapture of several specimens, it can be concluded with certainty that this species has entered into the risk assessment area. The exact number that were introduced is uncertain but may potentially be a few hundred.

There is also the potential for escapes from seafood merchants, or further releases of animals purchased by members of the public. However, there have only been three other substantiated reports of the capture of this species outside its' native range, and this is the first report in the UK indicating that this was a rare event. Anecdotally, it is reported that there are two importers, which between them import a few hundred Kg per month at most (Fish Health Inspectorate, pers. comm.).

Commercial fishery management regulations throughout their native range only allow male animals to be landed. As these fisheries are the only source of animals imported for human consumption the vast majority, if not all of the animals arriving in the risk assessment area via this route will be male, thereby greatly limiting their invasive potential. Checks and certifications for import/export are mainly concerned with the health/vitality of the animals and probably do not check on their sex. There are reports of the illegal harvesting of female Dungeness crabs generally among recreational gatherers and smaller operators (e.g. <http://www.seattletimes.com/seattle-news/putting-the-pinch-on-illegal-crabbers/>). Crabs for export will almost certainly have originated from *bona fide* fishery operators who comply with the legislation. Their sex can be easily distinguished by the shape of their abdomens, although it is possible that the occasional female may pass through for export through mistakes by legitimate operators. It is therefore concluded that the live import route, whilst it is *moderately likely* to result in the entry of live crabs into the coastal waters of GB, it is considered *unlikely* that any of these will be female specimens (or mated female specimens).

Planktonic larval stages may also be introduced to the risk assessment area through the movement of ballast water and other mechanical means. The distance between the native range and the risk assessment area is very large, so it is likely that the vast majority would die off in transit.

Establishment Summary

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

[Delete accordingly]

Response: *very unlikely* / **unlikely** / *moderately likely* / *likely* / *very likely*

Confidence: *very low* / *low* / **moderate** / *high* / *very high*

Comments (state where in GB this species could establish in your comments, include map if possible):

Coastal waters throughout GB are likely to be able to support the species as the temperature and salinity regime is suitable and areas of appropriate habitat are present throughout. They can tolerate reduced salinities, but show avoidance behaviour at salinities of less than 15ppt (Pauley et al, 1989). They are generalist carnivores so should be capable of finding sufficient prey. However, as the main route of potential introduction will convey male animals into GB (with the possibility of the occasional female) it is considered *unlikely* that they will be

able to establish self-sustaining populations here. Should a mixed sex batch or fertilized females be introduced, the risk of establishment would be higher, but there is no evidence to suggest that this would occur via the live import pathway. In their native range recruitment success varies considerably from year to year, and there is great uncertainty about how successful recruitment of this species in GB waters would be.

Spread Summary

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

[Delete accordingly]

Response: *very slow* / *slow* / ***intermediate*** / *rapid* / *very rapid*

Confidence: *very low* / ***low*** / *moderate* / *high* / *very high*

Comments (in your comments discuss how much of the total habitat that the species could occupy has already been occupied; also comment on how much of that currently unoccupied area is likely to be occupied within 5 years; also list all of the spread pathways):

Almost all of the potential habitat available for this species within GB is currently unoccupied by this species, so there is a large potential for them to spread, assuming they can breed and are suitably competitive within GB coastal waters.

Adults and juveniles move by walking (not swimming) and so may be potentially capable of moving a kilometre or two per day, although when in suitable habitat it is likely that they will have a tendency to remain there. An introduction of adult males may therefore potentially spread perhaps up to about 100 km from their release point during the course of a year.

Dungeness crabs breed on an annual basis so if a self-sustaining population became established, their spread would take the form of annual increments. Spread though breeding may cover large distances and potentially cross areas which would prove barriers to adults as their planktonic larval stage lasts for 3-4 months before they settle. Planktonic stages may also be transported around the assessment area by ballast water. Juveniles and possibly adults may be transported by other mechanical means, for example on the hulls of ships or through movements of aquaculture stocks.

Impact Summary

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

[Delete accordingly]

Response: *minimal* / *minor* / ***moderate*** / *major* / *massive*

Confidence: *very low* / ***low*** / *moderate* / *high* / *very high*

Comments (include list of impacts in your comments): As no self sustaining populations have been found in GB waters, and indeed anywhere outside of their native range, it is difficult to speculate with any confidence on the potential impacts such a population may have within the risk assessment area. Potential impacts may include the introduction of diseases which affect native crustaceans, displacement of native species from their niches, and predation upon native fauna. Hybridisation may pose a risk, although considered unlikely. The off-spring of such coupling may be sterile, so this may only be a localised and short term issue. If hybridisation resulted in fertile off-spring then this may be a more significant issue. No major potential disease issues have been identified, but this does not preclude the possibility, especially as there is a little known about the disease profile of this species.

There is great uncertainty about how Dungeness crabs may compete with other native crab species, although

they grow larger than most. It has been reported that the Dungeness crab is suspected of limiting the spread of introduced European shore crabs (*Carcinus maenas*) where they have been introduced in the Pacific. This suggests that they may out compete shore crabs at least, in certain situations. As a generalist predator, they will target a similar range of prey to native crab species, and it is possible that they may cause ecological changes, for example in sensitive sea grass areas. Their presence may affect brown crab (*Cancer pagarus*) populations, which is the main commercially exploited crab species. Brown crab tend to prefer rockier areas whereas Dungeness crabs tend to prefer sandy and muddy substrates so their overlap in terms of habitat will not be complete. The brown crab fishery may therefore be impacted to some extent, but reduced catches of brown crab would be compensated for to some extent by catches of Dungeness crabs, which will have a similar market value. The shore crab, the habitat preferences of which are more similar to the Dungeness crab, is not subject to a food fishery, but moulting shore crabs are collected commercially for fishing bait, and this industry may be negatively affected.

Climate Change

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

[Delete accordingly]

Response: *very low* / **low** / *moderate* / *high* / *very high*

Confidence: *very low* / *low* / **moderate** / *high* / *very 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): This species can tolerate temperatures of up to 25°C, but temperatures of over 17°C have been reported to cause mortalities in some cases. Summer temperatures in GB coastal waters are therefore approaching the maximum the species can tolerate, particularly in the south east of England. It is therefore considered that rises in sea temperatures are perhaps more likely to slightly reduce the geographical range that the species is capable of colonising in the risk assessment area. Specifically, the south east of England may become more marginal, but the rest of GB will remain suitable.

Conclusion

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

[Delete accordingly]

Response: *very low* / **low** / *moderate* / *high* / *very high*

Confidence: *very low* / **low** / *moderate* / *high* / *very high*

Comments: As there are no reports of the establishment or spread of this species outside of its native range despite the existence of potential pathways of introduction, it may be tentatively concluded that the overall risk is probably low. The biggest factor which is likely to have prevented this is the fishery regulations prohibiting the commercial landing of females of this species throughout its native range. Should these regulations change (considered unlikely) then the potential for this species to establish through international trade in live crabs will increase significantly. Introduction of the species through other routes (e.g. ballast water) are thought to be a remote possibility only.

Should a mixed sex introduction of a sufficient size occur, the establishment of a self-sustaining population will become a potential risk. As a generalist predator, some ecological impacts are likely to occur, but the exact nature of these are very hard to predict. The threat of disease introduction to native crustaceans is highly uncertain.

References

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

List:

Zhang, Z., Dunham, J.S., 2013 Construction of biological reference points for management of the Dungeness crab, *Cancer magister*, fishery in the Fraser River Delta, British Columbia, Canada. Fish. Res. Volume 139: 18–27

Pauley, G.B., Armstrong, D.A., Van Citter, C., Thomas, G.L., 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)—Dungeness crab. U.S. Fish. Wildl. Serv. Biol. Rep., 82(11.121) U.S. Army Corps of Engineers (1989), p. 20 TR EL-82-4

Holsman, K.K., McDonald, P.S., Armstrong, D.A., 2006. Intertidal migration and habitat use by subadult Dungeness crab *Cancer magister* in a NE Pacific estuary. Mar. Ecol. Prog. Ser. Vol. 308: 183–195

Komai, T., S. Maruyama & K. Konishi, 1992. A list of Decapod Crustaceans from Hokkaido, Northern Japan. Researches on Crustacea, 21: 189-205.

Regulations (male only for commercial harvest)

California - <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=34263&inline=true>

Oregon - <http://www.dfw.state.or.us/mrp/shellfish/commercial/crab/index.asp>

Washington - <http://wdfw.wa.gov/fishing/commercial/crab/coastal/>

Canada – www.pac.dfo-mpo.gc.ca/fm-gp/mplans/2013/crab-crabe-2013-eng.pdf

Alaska - <http://www.adfg.alaska.gov/index.cfm?adfg=fishregulations.commercial>