

Hemigrapsus sanguineus (Asian shore crab)

- Small crab with square shell. Aggressive and highly opportunistic omnivore.
- Individuals recorded in south Wales and Kent, England.
- Found in estuarine and marine habitats, within intertidal or shallow subtidal zones.
- May impact on commercial shellfish populations and native crabs.
- A second species of *Hemigrapsus* (*H. takanoi*) was discovered in August 2014. This summary sheet is for *H. sanguineus*.

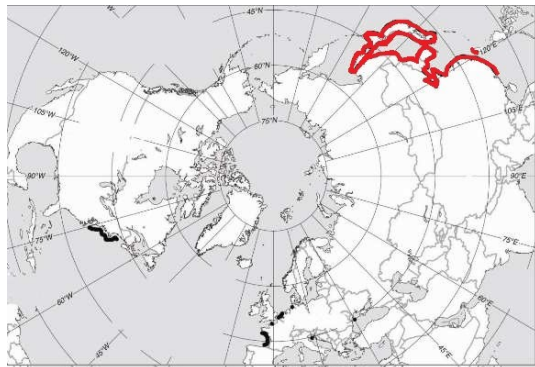


History in GB

First recorded in GB in April 2014, with specimens found on the coast of south Wales (1 individual) and Kent (3 individuals). Ecological conditions in GB are similar to those found along the NE coastline of Europe (including Jersey and Guernsey), where this species has dispersed widely and rapidly. A specimen of a second species, *Hemigrapsus takanoi* (brush clawed crab), was recorded on the Medway Estuary in August 2014.

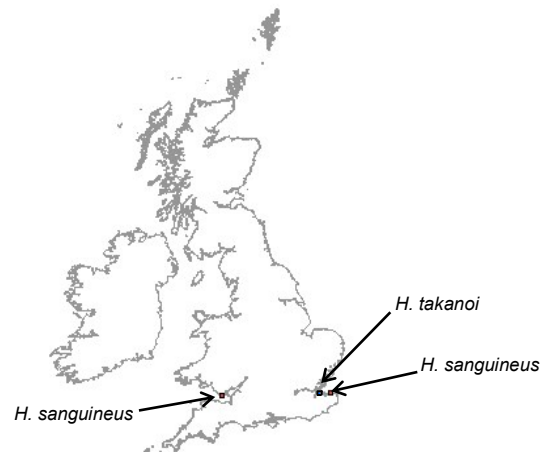
Native distribution

Native to the western Pacific Ocean from Russia, along the Korean and Chinese coasts, and Japanese archipelago.



Native range in red. Adapted from Klassen G (2012).

Distribution in GB



Source: NBN Gateway 2014

Impacts

Environmental

- Aggressive and highly opportunistic omnivore, may significantly affect native crab, fish and shellfish populations by disrupting the food web.

Economic

- Known to feed on commercially important species such as shellfish (mussels/oysters), especially juveniles / small specimens, which could threaten cultivation.
- Likely to compete with native intertidal crabs such as *Carcinus maenas*, which is exploited in some fishing communities in GB.

Social

- None recorded.

Introduction pathways

Hitchhiking - in hull fouling / ballast water of coastal shipping.

Natural dispersal - from its non-native range in NE Europe.

Larvae have potential to be transported over great distances.

Spread pathways

Natural - rapid spread due to highly effective breeding strategy; produces more than 5 broods per season, with as many as 56,000 eggs per spawning.

Translocation - in hull fouling / ballast water of coastal shipping, or in movement of shellfish from one region to another.

Summary

	Risk	Confidence
Entry	VERY LIKELY	HIGH
Establishment	VERY LIKELY	HIGH
Spread	RAPID	HIGH
Impacts	MAJOR	HIGH
Conclusion	HIGH	HIGH

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: *Hemigrapsus sanguineus* (de Haan, 1835), Asian Shore Crab
Author: Paul Clark

Version: Final (April 2016) – Draft 1 (May 2014), Draft 2 (June 2014), Peer review (June 2014), NNRAP 1st review (July 2014), Draft 2 (August 2014), NNRAP 2nd review (October 2014)

Signed off by NNRAP: October 2014

Approved by Programme Board: September 2015

Placed on NNS website: November 2015

GB Non-native species Rapid Risk Assessment (NRA)

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: A sighting of this species was reported in GB in May 2014 (details below).

This specimen was photographed on 2 May 2014, in the intertidal zone, near Aberthaw B Power Station, Aberthaw, Barry, Glamorgan, South Wales. Grid ref. ST020662.

The fate of this specimen remains unknown, as the photographer did not state if the crab was killed or returned to the local area. However, as a consequence of the record, the National Resources Wales has already undertaken surveys of the risk area. They did not report any further sightings of *Hemigrapsus sanguineus*.

Possible vector is hull fouling of shipping. Harbour facilities at Barry are in close proximity to the east of reported capture.

A second Asian shore crab specimen was observed on the intertidal rocky grounds at the end of Hampton Jetty, Herne Bay, Kent, England on 3 April, 12 and 14 May 2014. The male specimen was released on the first two occasions and it was photographed on 14 May and then destroyed.

Distinguishing features of *Hemigrapsus sanguineus* include a squarish carapace bearing 3 teeth on the anterolateral margin; an almost straight front divided into two shallow lobes; a fleshy vesicle at the base of cheliped dactyl; a suborbital stridulation organ comprising a finely, continuous striated crest not divided into three unequal parts and pereopods 2-5 (walking legs) with a distinctive pattern of light and dark bands.

Roy et al. 2014 considered which invasive alien species were most likely to impact on native biodiversity but were not yet established in the wild in Great Britain. *Hemigrapsus sanguineus* was identified as posing a 'high risk' (see Roy et al. 2014: table 2).

The reason for this risk assessment is to assess the potential risk to Great Britain.

2 - What is the Risk Assessment Area?

Response: The risk assessment area is Great Britain (i.e. England, Wales, Scotland)

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

Response:

Scientific name = *Hemigrapsus sanguineus*.

Junior synonym = *Heterograpsus maculatus* H. Milne Edwards, 1853.

Vernacular or common name = Asian shore crab or Japanese shore crab.

Native of North West Pacific coasts, from China, Hong Kong, Taiwan, Korea, Russia, and Japan.

Systematics

Infraorder Brachyura Linnaeus, 1758 (true crabs)

Section Eubrachyura Saint Laurent, 1980

Subsection Thoracotremata Guinot, 1977

Superfamily Grapsoidea MacLeay, 1838

Family Varunidae H. Milne Edwards, 1853

Subfamily Varuninae H. Milne Edwards, 1853

Genus *Hemigrapsus* Dana, 1851

Species *Hemigrapsus sanguineus* (de Haan, 1835)

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

Response: *Hemigrapsus sanguineus* has been introduced to the eastern coast of USA with a reported distribution from north of Cape Cod, Massachusetts southwards to Oregon Inlet, North Carolina and in Europe from, Guernsey and Jersey in the west, eastwards along the coastlines of Northern France, Belgium, Netherlands, Germany and Rømø Island, Denmark. Single male specimens have been recorded from Croatia (Adriatic) and Romania (Black Sea) in August 2001 and 27 August 2008 respectively.

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

Response: Two adult males have been reported, one from Glamorgan South Wales (fate unknown) and the other from Kent, England (destroyed).

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.

The area of UK capture was an intertidal rocky shore with a range of salinities and temperatures; similar ecological conditions found along the north east European mainland from France to Rømø Island, Denmark where it has been reported as an invasive species. No special conditions are required by this species except salinities ≥ 19 (Gittenberger et al. 2010).

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.

Hemigrapsus sanguineus could easily survive and thrive along the coastlines of England and Wales.

According to Dauvan et al. (2009), “*Hemigrapsus sanguineus* was found in abundance on the rocky shores of the Opal Coast from the Alprech Cape to the Gris Nez Cape, on the French side of the Dover Strait, under the boulders on soft-bottoms composed mainly of fine sand and gravel. The entire eulittoral zone appeared to be colonised, but during the spring sampling period (April-May), the mid-eulittoral was the preferred habitat of this shore crab. This was in agreement with the observations of C. d’Udekem d’Acoz (pers. comm. to Dauvan et al. 2009) in the Eastern Scheldt, the Netherlands where, *H. sanguineus* was found rather high on the shore and not on the lowest part of the shore”. The Asian shore crab can tolerate a wide range of salinities and temperatures. In the northern Wadden Sea have survived three winters in a row (2010-2012) in which ice covered the shore (Landschoff et al. 2013) and water temperatures dropped to -2°C. *Hemigrapsus sanguineus* aggregated, slowly crawling, even with ovigerous females, under boulders at low tide level (pers. obs. Landschoff et al. 2013). According to Gittenberger et al. (2010), *H. sanguineus* is only found at locations with a salinity of ≥ 19 .

Great Britain has similar ecological conditions to those found along the coastlines of the Opal coast, southern English Channel, southern North Sea and the Wadden Sea from where it has been recorded as an invasive species.

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: NA

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

Response: Yes - both.

Since the first record from Le Havre in 1999, *H. sanguineus* has dispersed over 1200km to include the Channel Islands and south to Granville westwards and east along the Opal Coast and Wadden Sea to Rømø Island, Denmark in ca. 10 years. This rapid spread has been due to their remarkably adaptive breeding strategy/development cycle and the longshore transport of larvae by the prevailing currents from a single site coupled with probable multiple introductions by hitchhiking in hull fouling of coastal shipping because *H. sanguineus* can cling to surfaces, hide in narrow crevices, travel on ship trunks, in anchor boxes, on ropes, and inside ballast water systems (see Landschoff et al. 2013). Dispersal by human assistance via transportation of shellfish such as mussels and oysters may also be an issue.

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

Response: *Hemigrapsus sanguineus* is an aggressive and highly opportunistic omnivore. It is known to feed on commercially important species of shellfish (mussels/oysters) especially juveniles/small specimens, therefore effecting recruitment. The Asian shore crab will be a competitor for native intertidal crabs especially *Carcinus maenas*, a species that is commercially exploited in some areas of GB. Populations of *C. maenas* could decline (see Jensen et al. 2002). *Cancer pagurus* and *Necora puber* have an intertidal juvenile phase. However, to date, there are no reports of *Hemigrapsus sanguineus* competing with these commercial important species although along the eastern coast of USA the Asian shore crab has competed with larger species, e.g., *Callinectes sapidus* and *Cancer irroratus* (Gerard et al. 1999; Tyrell and Harris 1999; Jensen et al. 2002).

Hemigrapsus sanguineus will prey on a wide range of invertebrate species.

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: *high*

Comments (include list of entry pathways in your comments):

Hemigrapsus sanguineus has already successfully invaded the French side of the English Channel from Granville on the west side of the Cotentin Peninsular including Guernsey and Jersey along the Normandy coast westward from Le Havre to the Opal Coast along the coastline of the Wadden Sea, southern North Sea and North to Rømø Island, Denmark (ca. over 1200km). Dauvin and Dufossé (2011) state that in the most abundantly colonised sites, the maximal densities per square meter were higher than 50 (i.e., at La Hougue in 2009, at La Hougue, Gatteville and Dunkirk harbour in 2010). Recently, Landschoff et al. (2013) record that in the Wadden Sea, *H. sanguineus* has become established on artificial-boulder shorelines, with peak densities of >100 crabs (>5 mm carapace width) per m² being attained within 2–3 years of arrival. Female crabs have been reported all year round (Landschoff et al. 2013; JC Geburzi pers. comm., Zoological Museum Kiel)

The rapid dispersal of *H. sanguineus* along the NE coastline of Europe has been attributed to the longshore transport of larvae by the prevailing currents from single sites, coupled with probable multiple introductions by hitchhiking in hull fouling of coastal shipping because the Asian shore crab can cling tightly to surfaces, hide in narrow crevices, travel on ship trunks, in anchor boxes, on ropes, and inside ballast water systems (see Landschoff et al. 2013).

An additional possibility for this species to populate the southern coast of GB is via natural dispersal from its non-native range in NE Europe. The six larval stages are planktonic for ca. 4-6 weeks before metamorphosing into juvenile crabs. Therefore, depending on weather/sea conditions, such as prolonged strong easterly winds, the larvae have the potential to be transported over great distances, including across the English Channel, which at Calais is only ca. 35.4km, and south North Sea.

Establishment Summary

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

Response: *very likely*

Confidence: *high*

Minchin et al. (2013) commented that 90 non-native species have been recorded from British marine and brackish waters; of these 31 alien species can tolerate reduced salinity. Their results showed that over 64% of these alien species have established populations. Furthermore they note that 35 of the 90 alien species originated from the North Pacific, with 82% of these having become established in British waters. *Hemigrapsus sanguineus* certainly falls within these parameters and therefore is very likely to be established.

There are no ecological reasons why *Hemigrapsus sanguineus* could not become extensively established along intertidal rocky shorelines throughout the British Isles and Ireland. No special conditions are required by this species in temperate regions as it can tolerate a wide range of salinities and temperatures. Ecological conditions in the British Isles and Ireland are similar to those found along the NE coastline of Europe where this species has dispersed widely and rapidly.

Spread Summary

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

Response: *rapid*

Confidence: *high*

On the eastern seaboard of the USA, *H. sanguineus* was first report outside of its native area by Williams and McDermott (1990); a live ovigerous specimen was collected in Townsend Inlet, Cape May County, New Jersey, 39°07'06"N, 74°43'00"W, United States, on the 24th September 1988, by 1990 a breeding population was established (McDermott 1991) and, ca. 25 years, to date this crab has a reported along the eastern seaboard from North Carolina to north of Cape Cod, Massachusetts. McDermott (1998) reports that between 1988 and 1995 the crab dispersed more than 650km.

The dispersal of *H. sanguineus* along the NE coastline of Europe has also been rapid since its first introduction to Le Harve in 1999 and it now has a range of over 1200km to Rømø Island, Denmark.

Once established, *Hemigrapsus sanguineus* can disperse rapidly because this species has an extremely effective breeding strategy i.e., producing more than 5 broods per season (in fact recent reports from NE Europe indicate females being ovigerous all the year round) with as many as ca. 56,000 eggs per spawning. Therefore this crab can disperse rapidly by natural means. It can also be disperse much wider with Human assistance via larvae in ballast water and by hull fouling on coastal shipping. Translocation of shellfish containing *Hemigrapsus* crabs from one region to another is another distinct possibility.

Impact Summary

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

Response: *major*

Confidence: *high*

Hemigrapsus sanguineus is an aggressive and highly opportunistic omnivore. It is known to feed on commercially important species such as shellfish (mussels/oysters) especially juveniles/small specimens, therefore effecting recruitment with the result of possible declining populations and possibly threatening cultivation.

It will be a competitor for native intertidal crabs especially *Carcinus maenas*, a species that is commercially exploited in some fishing communities in GB.

Invertebrate prey species of *Hemigrapsus sanguineus* could decline.

Dauvin and Dufossé (2011) state that in the most abundantly colonised sites, the maximal densities per square meter were higher than 50 (i.e., at La Hougue in 2009, at La Hougue, Gatteville and Dunkirk harbour in 2010).

Climate Change

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

Response: *low*

Confidence: *high*

Not an immediate issue for this species as the water temperature would have to rise significantly to have an effect.

Conclusion

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

Response: *high*

Confidence: *high*

Comments: Already reported from the Normandy coast of France, Guernsey and Jersey, along the Opal Coast, France to Belgium and Holland, all of which are easily accessible to pleasure craft from the south coast of Wales and the south coast of England. There is also considerable commercial shipping traffic between the UK with Le Havre and Dutch Ports, both with viable reproducing populations of *Hemigrapsus sanguineus*. It is only a matter of time before *Hemigrapsus sanguineus* becomes well established along the south coasts of England and Wales, from which they will disperse northwards along the east and west coastlines (see Minchin et al. 2013).

References

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

List:

Selected Web sites

The Rhode Island Marine and Estuarine Invasive Species Site. <http://www.rimeis.org/species/hemigrapsus.html>

Nonindigenous Species Information Bulletin, United States Geological Survey.

http://fl.biology.usgs.gov/Nonindigenous_Species/Asian_shore_crab/asian_shore_crab.html

Global Invasive Species Database

<http://www.issg.org/database/species/ecology.asp?si=756>

Selected References

Bréton G, Faasse M, Noël P, Vincent T (2002) A new alien crab in Europe: *Hemigrapsus sanguineus* (Decapoda: Brachyura: Grapsidae). *Journal of Crustacean Biology* 22: 184–189, doi:10.1651/0278-0372(2002)022[0184:ANACIE] 2.0.CO;2

Brousseau DJ, Filipowicz A, Baglivo, JA (2001) Laboratory investigations of the effects of predator and size on prey selection by the Asian crab, *Hemigrapsus sanguineus*. *Journal of Experimental Marine Biology and Ecology*, 262:199–210.

Brousseau DJ, Korchari PG, Pflug C (2000) Food preference studies of the Asiatic shore crab (*Hemigrapsus sanguineus*) from western Long Island Sound. In Pederson J. (ed.) *Marine Bioinvasions: Proceedings of the First National Conference*, Cambridge, MA, 24-27 January 1999 Cambridge, MA, USA: MIT Sea Grant College Program, 200-207.

Dauvin JC (2009a) Establishment of the invasive Asian shore crab *Hemigrapsus sanguineus* (De Haan, 1835) (Crustacea: Brachyura: Grapsoidea) from the Cotentin Peninsula, Normandy, France. *Aquatic Invasions* 4: 467–472, doi:10.3391/ai.2009.4.3.4

Dauvin JC (2009b) Asian shore crabs *Hemigrapsus* spp. (Crustacea: Brachyura: Grapsoidea) continue their invasion around the Cotentin Peninsula, Normandy, France: Status of the *Hemigrapsus* population in 2009. *Aquatic Invasions* 4: 605–611, doi:10.3391/ai.2009.4.4.6

Dauvin JC, Tous Rius A, Ruellet T (2009) Recent expansion of two invasive crabs species *Hemigrapsus sanguineus* (De Haan, 1853) and *H. takonei* Asakura & Watanabe, 2005 along the Opal coast, France. *Aquatic Invasions* 4: 451–465, doi:10.3391/ai.2009.4.3.3

Dauvin JC, Dufossé F (2011) *Hemigrapsus sanguineus* (De Haan, 1835) (Crustacea: Brachyura: Grapsoidea) a new invasive species in European waters: the case of the French English Channel coast (2008–2010). *Aquatic Invasions* 6(3): 329–338, doi: 10.3391/ai.2011.6.3.09

Faasse MA (2004) Opmars van de blaasjeskrab (*Hemigrapsus sanguineus* de Hann, 1835) in Nederland. *Het Zeepaard* 64: 143-144.

Gerard VA, Cerrator RM, Larson AA (1999) Potential impacts of a western Pacific grapsid crab on intertidal communities of the northwestern Atlantic Ocean. *Biological Invasions* 1: 353–361, doi:10.1023/A:1010093329077

Gittenberger A, Rensing M, Stegenga H, Hoeksema B (2010) Native and non-native species of hard substrata in the Dutch Wadden Sea. *Nederlandse Faunistische Mededelingen* 33: 21–76.

Landschoff J, Lackschewitz D, Keszy K, Reise K (2013) Globalization pressure and habitat change: Pacific rocky shore crabs invade armored shorelines in the Atlantic Wadden Sea. *Aquatic Invasions* 8: 77–87. doi:

<http://dx.doi.org/10.3391/ai.2013.8.1.09>

Fukui Y (1988) Comparative studies on the life history of the grapsid crabs (Crustacea, Brachyura) inhabiting intertidal cobble and boulder shores. *Publ. Seto Mar. Biol. Lab.* 33: 121–162.

Hwang SG, Lee C, Kim CH (1993) Complete larval development of *Hemigrapsus sanguineus* (Decapoda, Brachyura, Grapsidae) reared in laboratory. *Korean Journal of Systematic Zoology*, 9: 69–86.

Jensen GC, McDonald PS, Armstrong DA (2002) East meets west: competitive interactions between green crab *Carcinus maenus*, and native and introduced shore crab *Hemigrapsus* spp. *Marine Ecology Progress Series*, 225: 251–262.

Leppäkoski E, Olenin S (2000) Non-native species and rates of spread: lessons from the brackish Baltic Sea. *Biological Invasions* 2: 151–165, doi:10.1023/A:1010052 809567

Ledesma ME, O'Connor NJ, (2001) Habitat and diet of the non-native crab *Hemigrapsus sanguineus* in southeastern New England. *Northeastern Naturalist*, 8(1): 63–78.

Lohrer AM, (2001) The invasion by *Hemigrapsus sanguineus* in eastern North America: a review. *Aquatic Invaders*, 12(3): 1-11.

Lohrer AM, Fukui Y, Wada K, Whitlatch RB (2000) Structural complexity and vertical zonation of intertidal crabs, with focus on the habitat requirements of the invasive Asian shore crab, *Hemigrapsus sanguineus* (de Haan). *Journal of Experimental Marine Biology and Ecology*, 244: 203–217.

Lohrer, A.M., Whitlatch, R.B., 2002b. Relative impacts of two exotic brachyuran species on blue mussel populations in Long Island Sound. *Mar. Ecol. Prog. Ser.* 227, 135–144. <http://dx.doi.org/10.3354/meps227135>.

Lord R (2010) Asian shore crab, *Hemigrapsus sanguineus*, reaches shores of Channel Islands. *Sustainable Guernsey* [online]. Available from: <http://www.sustainableguernsey.info/blog/2010/04/asian-shore-crab-hemigrapsus-sanguineus-reaches-shores-of-channel-islands/>

McDermot, JJ (1991) A breeding population of the western Pacific crab *Hemigrapsus sanguineus* (Crustacea: Decapoda: Grapsidae) established on the Atlantic coast of North America. *Biological Bulletin (Woods Hole)*, 181: 195–198.

McDermott, J. J. (1991b). Incidence and host-parasite relationship of *Leidyia bimini* (Crustacea, Isopoda, Bopyridae) in the brachyuran crab *Pachygrapsus transversus* from Bermuda. *Ophelia*, 33(2), 71-95.

McDermott J (1998) The western Pacific brachyuran (*Hemigrapsus sanguineus*: Grapsidae) in its new habitat along the Atlantic coast of the United States: geographic distribution and ecology. *ICES Journal of Marine Science* 55: 289–298, doi:10.1006/jmsc.1997.0273

McDermott JJ (1999) The western Pacific brachyuran *Hemigrapsus sanguineus* (Grapsidae) in its new habitat along the Atlantic coast of the United States: feeding, cheliped morphology and growth. In: Schram F, von Vaupel Klein J [eds.] *Crustaceans and the biodiversity crisis. Proceedings of the Fourth International Crustacean Congress*, Amsterdam, the Netherlands, 20-24 July 1998 Brill, Leiden, The Netherlands, 425-444.

Micu D, Niță V, Todorova V (2010) First record of the Japanese shore crab *Hemigrapsus sanguineus* (de Haan, 1835) (Brachyura: Grapsoidea: Varunidae) from the Black Sea. *Aquatic Invasions* 5, Supplement 1: S1–S4

Minchin D, Cook EJ, Clark PF (2013) Alien species in British brackish and marine waters. *Aquatic Invasions*, 8(1): 3–19.

Nijland R, Faasse M, (2005) Meer vindplaatsen van de blaasjeskrab *Hemigrapsus sanguineus* (de Haan, 1835) in Nederland [More localities for the Asian shore crab *Hemigrapsus sanguineus* (de Haan, 1835) in the Netherlands]. *Het Zeepaard*, 65(5): 151–152.

Obert B, Herlyn M, Grotjahn M (2007) First records of two crabs from the North West Pacific *Hemigrapsus sanguineus* and *H. takanoi* at the coast of Lower Saxony, Germany. *Wadden Sea Newsletter* 2007: 21–22.

Roy HE, Peyton J, Aldridge DC, Bantock T, Blackburn TM, Britton R, Clark P, Cook E, Dehnen-Schmutz K, Dines T, Dobson M, Edwards F, Harrower C, Harvey MC, Minchin D, Noble DG, Parrott D, Pocock MJO, Preston CD, Roy S, Salisbury A, Schönrogge K, Sewell J, Shaw RH, Stebbing P, Stewart AJA, Walker KJ (2014) Horizon scanning for invasive alien species with the potential to threaten biodiversity in Great Britain. *Global Change Biology* DOI: 10.1111/gcb.12603

Tyrrell M, Harris L (1999) Potential impacts of introduced Asian shore crab, *Hemigrapsus sanguineus*, in northern New England, diet, feeding preferences, and overlap with the green crab, *Carcinus maenas*. *Proceedings of the First National Conference, 24–27 January, 1999 The MIT Sea Grant Program, Cambridge, MA* 00(2):208–220.

Schubart C (2003) The East Asian shore crab *Hemigrapsus sanguineus* (Brachyura: Varunidae) in the Mediterranean Sea: an independent human-mediated introduction. *Scientia Marina* 67: 195–200.

d’Udekem C (2006) First record of the Asian shore crab *Hemigrapsus sanguineus* (De Haan, 1835) from Belgium (Crustacea: Brachyura: Grapsoidae). *De Strandvlo* 26(3): 74–82.

Williams A, McDermott J (1990) An eastern United States record for the western Indopacific crab, *Hemigrapsus sanguineus* (Crustacea: Decapoda: Grapsidae). *Proceedings of the Biological Society of Washington* 103: 108–109.