NEW YORK
FISH & AQUATIC INVERTEBRATE INVASIVENESS RANKING FORM

Scientific name:	Hemigrapsus sanguineus
Common names:	Asian Shore Crab, Japanese Shore Crab
Native distribution:	Asia-Pacific region-western Pacific Ocean from Russia, along the Korean and Chinese coasts to Hong Kong, and the Japanese archipelago.
Date assessed:	1/22/13, 1/24/13
Assessors:	E. White
Reviewers:	
Date Approved:	Form version date: 3 January 2013

New York Invasiveness Rank: Very High (Relative Maximum Score >80.00)

Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form***)**			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program	Not Assessed	Not Assessed
2	Capital/Mohawk	Not Assessed	Not Assessed
3	Catskill Regional Invasive Species Partnership	Not Assessed	Not Assessed
4	Finger Lakes	Not Assessed	Not Assessed
5	Long Island Invasive Species Management Area	Not Assessed	Not Assessed
6	Lower Hudson	Not Assessed	Not Assessed
7	Saint Lawrence/Eastern Lake Ontario	Not Assessed	Not Assessed
8	Western New York	Not Assessed	Not Assessed

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	30 (20)	20
2	Biological characteristic and dispersal ability	30 (26)	24
3	Ecological amplitude and distribution	30 (24)	21
4	Difficulty of control	10 (10)	6
	Outcome score	100 (80)[b]	71[a]
	Relative maximum score †		88.75
	New York Invasiveness Rank §	Very High (Relative Maximum Score >80.00)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."
†Calculated as 100(a/b) to two decimal places.
§Very High >80.00; High 70.00−80.00; Moderate 50.00−69.99; Low 40.00−49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented in NY? (reliable source; voucher not required)	
☒	Yes – continue to A1.2
☐	No – continue to A2.1; Yes ☐ NA; Yes ☐ USA
A1.2. In which PRISMs is it known (see inset map)?	
☐	Adirondack Park Invasive Program
☐	Capital/Mohawk
☐	Catskill Regional Invasive Species Partnership
☐	Finger Lakes
☒	Long Island Invasive Species Management Area
☒	Lower Hudson

☐	Saint Lawrence/Eastern Lake Ontario
☐	Western New York

Documentation:
Sources of information:
(The Nature Conservancy 2013, U.S. Geological Survey 2013)

A2.0. Is this species listed on the Federal Injurious Fish and Wildlife list?
☐ Yes – the species will automatically be listed as Prohibited, no further assessment required.
☒ No – continue to A2.1

A2.1. What is the likelihood that this species will occur and persist given the climate in the following PRISMs? (obtain from PRISM invasiveness ranking form and/ or Climatch score)

Unlikely	Adirondack Park Invasive Program
Unlikely	Capital/Mohawk
Unlikely	Catskill Regional Invasive Species Partnership
Unlikely	Finger Lakes
Very Likely	Long Island Invasive Species Management Area
Very Likely	Lower Hudson
Unlikely	Saint Lawrence/Eastern Lake Ontario
Unlikely	Western New York

Documentation:
Sources of information (e.g.: distribution models, literature, expert opinions):

If the species does not occur and is not likely to survive and reproduce within any of the PRISMs, then stop here as there is no need to assess the species.

A2.2. What is the current distribution of the species in each PRISM? (obtain rank *from PRISM invasiveness ranking forms*)

	Distribution
Adirondack Park Invasive Program	Not Assessed
Capital/Mohawk	Not Assessed
Catskill Regional Invasive Species Partnership	Not Assessed
Finger Lakes	Not Assessed
Long Island Invasive Species Management Area	Not Assessed
Lower Hudson	Not Assessed
Saint Lawrence/Eastern Lake Ontario	Not Assessed
Western New York	Not Assessed

Documentation:
Sources of information:

A2.3. Describe the potential or known suitable habitats within New York. Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

Aquatic Habitats	Wetland Habitats	Upland Habitats
☒ Marine	☐ Salt/brackish marshes	☐ Cultivated*
☒ Salt/ brackish waters	☐ Freshwater marshes	☐ Grasslands/old fields
☒ Freshwater tidal	☐ Peatlands	☐ Shrublands
☐ Rivers/streams	☐ Shrub swamps	☐ Forests/woodlands
☐ Natural lakes and ponds	☐ Forested wetlands/riparian	☐ Alpine
☐ Vernal pools	☐ Ditches*	☐ Roadsides*
☐ Reservoirs/ impoundments*	☐ Beaches/or coastal dunes	☐ Cultural*

Other potential or known suitable habitats within New York:

Documentation: Inhabits rocky intertidal zones and sometimes subtidal habitat. It is known from freshwater tidal habitat in NY (Hudson River).

Sources of information:
McDermott, 1998; Invasive Species Specialist Group (ISSG), 2013; Richerson, 2013.

B. INVASIVENESS RANKING

1. ECOLOGICAL IMPACT

1.1. Impact on Ecosystem Processes and System-wide Parameters (e.g., water cycle, energy cycle, nutrient and mineral dynamics, light availability, or geomorphological changes (erosion and sedimentation rates).

A.	No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years.	0
B.	Influences ecosystem processes to a minor degree, has a perceivable but mild influence	3
C.	Significant alteration of ecosystem processes	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes	10
U.	Unknown	

Score U

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
H. sanguineus is dominant over other crab species and outcompetes them for food items (Lohrer et al. 2000, Kraemer and Sellberg 2001, Jensen et al. 2002). They consume snails, mussels, macroalgae, other invertebrates at a high rate, but studies are needed to determine the impact on these communities. They could play important role in structuring prey communities and light availability with their impact on algal community.
Sources of information:
(Lohrer *et al.* 2000, Kraemer and Sellberg 2001, Jensen *et al.* 2002)

1.2. Impact on Natural Habitat/ Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals of one or more native species in the community)	3
C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 10

Documentation:
Identify type of impact or alteration: *H. sanguineus* is dominant over other crab species and outcompetes them for food items (Lohrer et al. 2000, Kraemer and Sellberg 2001, Jensen et al. 2002). *H. sanguineus* consume snails, mussels, macroalgae, other invertebrates at a high rate, but studies are needed to determine the impact on these communities. Studies indicate strong influence in structuring prey communities, including declines of commercial shellfish (Gerard et al. 1999, Brousseau and Baglivo 2005). Kraemer and Sellberg 2001 show decline of native crab species with increase of *Hemigrapsus sanguineus*.
Sources of information:
(Gerard *et al.* 1999, Lohrer *et al.* 2000, Kraemer and Sellberg 2001, Jensen *et al.* 2002, Brousseau and Baglivo 2005)

1.3. Impact on other species or species groups, including cumulative impact of this species on other organisms in the community it invades. (e.g., interferes with native

predator/ prey dynamics; injurious components/ spines; reduction in spawning; hybridizes with a native species; hosts a non-native disease which impacts a native species)

A.	Negligible perceived impact	0
B.	Minor impact (e.g. impacts 1 species, <20% population decline, limited host damage)	3
C.	Moderate impact (e.g. impacts 2-3 species and/ or 20-29% population decline of any 1 species, kills host in 2-5 years, ,)	7
D.	Severe impact on other species or species groups (e.g. impacts >3 species and/ or ≥30% population decline of any 1 species, kills host within 2 years, extirpation)	10
U.	Unknown	

Score 10

Documentation:
Identify type of impact or alteration:
H. sanguineus is dominant over other crab species and outcompetes them for food items (Lohrer et al. 2000, Kraemer and Sellberg 2001, Jensen et al. 2002). They consume snails, mussels, macroalgae, other invertebrates at a high rate, but studies are needed to determine the impact on these communities. Studies indicate strong influence in structuring prey communities, including declines of commercial shellfish (Gerard et al. 1999, Brousseau and Baglivo 2005). Kraemer and Sellberg (2001) show decline of native crab species with increase of *Hemigrapsus sanguineus*.
Sources of information:
(Gerard *et al.* 1999, Lohrer *et al.* 2000, Kraemer and Sellberg 2001, Jensen *et al.* 2002, Brousseau and Baglivo 2005)

Total Possible 20
Section One Total 20

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)

A.	No reproduction (e.g. sterile with no sexual or asexual reproduction).	0
B.	Limited reproduction (e.g., intrinsic rate of increase <10%, low fecundity, complete one life cycle)	1
C.	Moderate reproduction (e.g., intrinsic rate of increase between 10-30%, moderate fecundity, complete 2-3 life cycles)	2
D.	Abundant reproduction (e.g., intrinsic rate of increase >30%, parthenogenesis, large egg masses, complete > 3 life cycles)	4
U.	Unknown	

Score 4

Documentation:
Describe key reproductive characteristics: Large females can produce more than 5 broods/year, with up to 56,000 eggs/brood (McDermott 1991). They have an extended spawning season (Epifanio et al. 1998).
Sources of information:
(McDermott 1991, Epifanio *et al.* 1998)

2.2. Migratory behavior

A.	Always migratory in its native range	0
B.	Non-migratory or facultative migrant in its native range	2
U.	Unknown	

Score 2

Documentation:
Describe migratory behavior: No migration noted in literature.

Sources of information:

2.3. Biological potential for colonization by long-distance dispersal/ movement (e.g., veligers, resting stage eggs, glochidia)

A.	No long-distance dispersal/ movement mechanisms	0
B.	Adaptations exist for long-distance dispersal, but studies report that most individuals (90%) establish territories within 5 miles of natal origin or within a distance twice the home range of the typical individual, and tend not to cross major barriers such as dams and watershed divides	1
C.	Adaptations exist for long-distance dispersal, movement and evidence that offspring often disperse greater than 5 miles of natal origin or greater than twice the home range of typical individual and will cross major barriers such as dams and watershed divides	2
U.	Unknown	

Score 2

Documentation:
Identify dispersal mechanisms:
An extended spawing season and wide tolerance for variation in environment make *H. sanguineus* well suited for dispersal along the east coast of the US (Epifanio et al. 1998). Larvae are suspended in water for a month and can travel great distances, having the potential to invade new areas (Richerson 2013, Park et al. 2004).
Sources of information:
(Epifanio *et al.* 1998, Park *et al.* 2004, Richerson 2013)

2.4. Practical potential to be spread by human activities, both directly and indirectly – possible vectors include: commercial bait sales, deliberate illegal stocking, aquaria releases, boat trailers, canals, ballast water exchange, live food trade, rehabilitation, pest control industry, aquaculture escapes, etc.)

A.	Does not occur	0
B.	Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient)	1
C.	Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent)	2
D.	High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful)	4
U.	Unknown	

Score U

Documentation:
Identify dispersal mechanisms:
The species is believed to be introduced near the site of first discovery south of Cape Cod (probably in the early 1980s) by ship ballast water from Asia; it is unknown if there was a single introduction event occurred or more (McDermott 1998). Ballast water management and monitoring needs to be established to determine this.
Sources of information:
(McDermott 1998, Richerson 2013)

2.5. Non-living chemical and physical characteristics that increase competitive advantage (e.g., tolerance to various extremes, pH, DO, temperature, desiccation, fill vacant niche, charismatic species)

A.	Possesses no characteristics that increase competitive advantage	0
B.	Possesses one characteristic that increases competitive advantage	4
C.	Possesses two or more characteristics that increase competitive advantage	8
U.	Unknown	

Score 8

Documentation:

Evidence of competitive ability:
Hemigrapsus sanguineus has a wide tolerance for salinity and temperature, at least in one life stage (Epifanio et al. 1998, Gerard et al. 1999, Lohrer et al. 2000, Kraemer and Sellberg 2001). It has been shown to be highly resistant to tetrodotoxin (TTX) (Shiomi et al. 1992).
Sources of information:
(Shiomi *et al.* 1992, Epifanio *et al.* 1998, Gerard *et al.* 1999, Lohrer *et al.* 2000, Kraemer and Sellberg 2001)

2.6. Biological characteristics that increase competitive advantage (e.g., high fecundity, generalist/ broad niche space, highly evolved defense mechanisms, behavioral adaptations, piscivorous, etc.)

A.	Possesses no characteristics that increase competitive advantage	0
B.	Possesses one characteristic that increases competitive advantage	4
C.	Possesses two or more characteristics that increase competitive advantage	8
U.	Unknown	

Score 8

Documentation:
Evidence of competitive ability:
Hemigrapsus sanguineus can produce more broods per year than native crabs (Epifanio et al. 1998, Lohrer et al. 2000). They are a more dominant competitor for food than other resident crabs and studies show their numbers increasing while native crab numbers decline. (Lohrer et al. 2000, Kraemer and Sellberg 2001, Jensen et al. 2002). At least one type of native crab, *Uca pugnax*, does not appear to be significantly affected by the introduction of *H. sanguineus* (Brousseau et al. 2003).
Sources of information:
(Epifanio *et al.* 1998, Lohrer *et al.* 2000, Kraemer and Sellberg 2001, Jensen *et al.* 2002, Brousseau *et al.* 2003, Invasive Species Specialist Group (ISSG) 2013)

2.7. Other species in the family and/ or genus invasive in New York or elsewhere?

A.	No	0
B.	Yes	2
U.	Unknown	

Score 0

Documentation: (Richerson 2013, The Nature Conservancy 2013)
Identify species:

Total Possible 26
Section Two Total 24

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Current introduced distribution in the northern latitudes of USA and southern latitude of Canada (e.g., between 35 and 55 degrees).

A.	Not known from the northern US or southern Canada.	0
B.	Established as a non-native in 1 northern USA state and/or southern Canadian province.	1
C.	Established as a non-native in 2 or 3 northern USA states and/or southern Canadian provinces.	2
D.	Established as a non-native in 4 or more northern USA states and/or southern Canadian provinces, and/or categorized as a problem species (e.g., "Invasive") in 1 northern state or southern Canadian province.	3
U.	Unknown	

Score 3

Documentation:

Identify states and provinces:
NC, VA, MD, DE, PA, NJ, NY, CT, RI, MA, NH, ME, Ottawa, Ontario
Atlantic coast of US from ME to NC
Sources of information:
- See known introduced range at www.usda.gov, and update with information from states and Canadian provinces.

(Richerson 2013)

3.2. Current introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)

A.	Established in none of the PRISMs	0
B.	Established in 1 PRISM	1
C.	Established in 2 or 3 PRISMs	3
D.	Established in 4 or more PRISMs	5
U.	Unknown	

Score 3

Documentation:
Describe distribution:
Long Island shore and Lower Hudson River
Sources of information:
(Richerson 2013, The Nature Conservancy 2013)

3.3. Number of known, or potential (each individual possessed by a vendor or consumer), individual releases and/ or release events

A.	None	0
B.	Few releases (e.g., <10 annually).	2
C.	Regular, small scale releases (e.g., 10-99 annually).	4
D.	Multiple, large scale (e.g., ≥100 annually).	6
U.	Unknown	

Score U

Documentation:
Describe known or potential releases:
This species is believed to be introduced near the site of first discovery south of Cape Cod (probably in the early 1980s) by ship ballast water from Asia; it is unknown if a single introduction event occurred or more (McDermott 1998).
Sources of information:
(McDermott 1998, Invasive Species Specialist Group (ISSG) 2013)

3.4. Current introduced population density, or distance to known occurrence, in northern USA and/ or southern Canada.

A.	No known populations established.	0
B.	Low to moderate population density (e.g., ≤1/4 to < 1/2 native population density) with few other invasives present and/ or documented in 1 or more non-adjacent state/ province and/ or 1 unconnected waterbody.	1
C.	High or irruptive population density (e.g., ≥1/2 native population density) with numerous other invasives present and/ or documented in 1 or more adjacent state/ province and/ or 1 connected waterbody.	2
U.	Unknown	

Score 2

Documentation:

Describe population density:
This species has been documented along the Atlantic coast of the US from ME to NC.
Sources of information:
(Richerson 2013)

3.5. Number of habitats the species may invade

A. Not known to invade any natural habitats given at A2.3. 0
B. Known to occur in 2 or 3 of the habitats given at A2.3, with at least 1 or 2 natural habitat(s). 2
C. Known to occur in 4 or more of the habitats given at A2.3, with at least 3 natural habitats. 3
U. Unknown.

Score 2

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
Inhabits rocky intertidal zones and subtidal habitat along Long Island shore. It is known from freshwater tidal habitat in NY (Hudson River).
Sources of information:
(McDermott 1998, Invasive Species Specialist Group (ISSG) 2013, Richerson 2013)

3.6. Role of anthropogenic (human related) and natural disturbance in establishment (e.g. water level management, man-made structures, high vehicle traffic, major storm events, etc).

A. Requires anthropogenic disturbances to establish. 0
B. May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances. 2
C. Can establish independent of any known natural or anthropogenic disturbances. 3
U. Unknown.

Score 3

Documentation:
Identify type of disturbance:

Sources of information:
(Epifanio *et al.* 1998, Park *et al.* 2004, Richerson 2013)

3.7. Climate in native range (e.g., med. to high, ≥5, Climatch score; within 35 to 55 degree latitude; etc.)

A. Native range does not include climates similar to New York (e.g., <10%). 0
B. Native range possibly includes climates similar to portions of New York (e.g., 10-29%). 4
C. Native range includes climates similar to those in New York (e.g., ≥30%). 8
U. Unknown.

Score 8

Documentation:
Describe known climate similarities:
Over 80 % of New York stations ranked >5.
Sources of information:
(Austrailian Department of Agriculture, Fisheries, and Forestry (ADAFF) 2013)

Total Possible 24
Section Three Total 21

4. DIFFICULTY OF CONTROL

4.1. Re-establishment potential, nearby propagule source, known vectors of re-introduction (e.g. biological supplies, pets, aquaria, aquaculture facilities, connecting

waters/ corridors, mechanized transportation, live wells, etc.)

A. No known vectors/ propagule source for re-establishment following removal. 0
B. Possible re-establishment from 1 vector/ propagule source following removal and/ or viable <24 hours. 1
C. Likely to re-establish from 2-3 vectors/ propagule sources following removal and/ or viable 2-7 days. 2
D. Strong potential for re-establishment from 4 or more vectors/ propagule sources following removal and/or viable >7 days. 3
U. Unknown.

Score 1

Documentation:
Identify source/ vectors:
Larvae may be present in the water column or disperse to new areas. Further introduction from ballast water is a possibility. An extended spawing season and wide tolerance for variation in the environment make this species well-suited for dispersal along the east coast of the US (Epifanio et al. 1998). Larvae are suspended in water for a month and can travel great distances, having the potential to invade new areas (Richerson 2013, Park et al. 2004).
Sources of information:
(Epifanio *et al.* 1998, Park *et al.* 2004, Richerson 2013)

4.2. Status of monitoring and/ or management protocols for species

A. Standardized protocols appropriate to New York State are available. 0
B. Scientific protocols are available from other countries, regions or states. 1
C. No known protocols exist. 2
U. Unknown

Score 1

Documentation:
Describe protocols:
Delaney et al. (2008) recently assessed the citizen science monitoring of this species across several states and feasibility of establishing national monitoring network. Harris and Dijkstra (2007) conducted a monitoring study on invasive species in Great Bay. Some groups are collecting data on sightings of this species and presumably maintaining a database of this information: Salem sound coastwatch of MA collects information on reported sightings http://www.salemsound.org/mis/MISHemigrapsus.pdf
USGS has a nonindigenous aquatic species hotline to report sightingshttp://nas.er.usgs.gov/SightingReport.asp
Illinois-Indiana Sea Grant (2013) suggests public education and monitoring of ballast discharge as well as tapping into existing or previous Asian shore crab research.
Sources of information: (Benson 2005, Harris and Dijkstra 2007, Delaney *et al.* 2008, Illinois-Indiana Sea Grant 2013, Salem Sound Coastwatch 2013)

4.3. Status of monitoring and/ or management resources (e.g. tools, manpower, travel, traps, lures, ID keys, taxonomic specialists, etc.)

A. Established resources are available including commercial and/ or research tools 0
B. Monitoring resources may be available (e.g. partnerships, NGOs, etc) 1
C. No known monitoring resources are available 2
U. Unknown

Score 1

Documentation:
Describe resources:
ID tools and methodologies for surveys may be available from those who have done previous studies. The model of the large-scale citizen science monitoring study and resulting standardized database can be built upon (Delaney et al. 2008). No suggestions for

control or eradication seem to exist.
Sources of information:
(Kraemer and Sellberg 2001, Delaney *et al.* 2008)

4.4. Level of effort required

A.	Management is not required. (e.g., species does not persist without repeated human mediated action.)	0
B.	Management is relatively easy and inexpensive; invasive species can be maintained at low abundance causing little or no ecological harm. (e.g., 10 or fewer person-hours of manual effort can eradicate a local infestation in 1 year.)	1
C.	Management requires a major short-term investment, and is logistically and politically challenging; eradication is difficult, but possible. (e.g., 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/ year for 2-5 years to suppress a local infestation.)	2
D.	Management requires a major investment and is logistically and politically difficult; eradication may be impossible. (e.g., more than 100 person-hours/ year of manual effort, or more than 10 person hours/year for more than 5 years to suppress a local infestation.)	3
U.	Unknown	

Score: 3

Documentation:
Identify types of control methods and time required:
There does not appear to be control of *H. sanguineus*, other than by native predators and preventative measures. It has been suggested that the parasites that help control the species in their native range are not present on the Atlantic coast of the US, but predators such as gulls and various fish species help reduce their populations (Benson 2005). Monitoring the species numbers and spread and research on ballast water management are suggested and currently underway. Education of the public is also an important component of any effort. Management will also likely require citizen science/volunteer monitoring effort of many person hours, but eradication estimates are not discussed in the literature.
Sources of information:
(Benson 2005, Delaney *et al.* 2008, Invasive Species Specialist Group (ISSG) 2013)

Total Possible	10
Section Four Total	6
Total for 4 sections Possible	80
Total for 4 sections	71

C. STATUS OF GENETIC VARIANTS AND HYBRIDS:

At the present time there is no protocol or criteria for assessing the invasiveness of genetic variants independent of the species to which they belong. Such a protocol is needed, and individuals with the appropriate expertise should address this issue in the future. Such a protocol will likely require data on cultivar fertility and identification in both experimental and natural settings.

Genetic variants of the species known to exist:

Hybrids (crosses between different parent species) should be assessed individually and separately from the parent species wherever taxonomically possible, since their invasiveness may differ from that of the parent species. An exception should be made if the taxonomy of the species and hybrids are uncertain, and species and hybrids can not be clearly distinguished in the field. In such cases it is not feasible to distinguish species and hybrids, and they can only be assessed as a single unit.

Hybrids of uncertain origin known to exist:

References for species assessment:

Austrailian Department of Agriculture, Fisheries, and Forestry (ADAFF). 2013. Climatch Mapping Tool [Online]. Available: http://adl.brs.gov.au:8080/Climatch/. [Accessed: 23-Jan-2013].

Benson, A. 2005. Asian shore crab, Japanese shore crab, Pacific crab, Hemigrapsus sanguineus. Non-indigenous Species Information Bulletin United States Geological service.

Brousseau, D. J., and J. A. Baglivo. 2005. Laboratory Investigations of Food Selection by the Asian Shore Crab, Hemigrapsus Sanguineus: Algal Versus Animal Preference. Journal of Crustacean Biology 25:130–134.

Brousseau, D. J., K. Kriksciun, and J. A. Baglivo. 2003. Fiddler crab burrow usage by the Asian crab, Hemigrapsus sanguineus, in a Long Island Sound salt marsh. Northeastern naturalist 10:415–420.

Delaney, D. G., C. D. Sperling, C. S. Adams, and B. Leung. 2008. Marine invasive species: validation of citizen science and implications for national monitoring networks. Biological Invasions 10:117–128.

Epifanio, C., A. Dittel, S. Park, S. Schwalm, and A. Fouts. 1998. Early life history of Hemigrapsus sanguineus, a non-indigenous crab in the Middle Atlantic Bight (USA). Marine Ecology Progress Series 170:1–238.

Gerard, V., R. Cerrato, and A. Larson. 1999. Potential impacts of a western Pacific grapsid crab on intertidal communities of the northwestern Atlantic Ocean. Biological invasions 1:353–361.

Harris, L. G., and J. A. Dijkstra. 2007. Seasonal appearance and monitoring of invasive species in the Great Bay estuarine system. Report to New Hampshire Estuaries Project, US Environmental Protection Agency National Estuaries Program.

Illinois-Indiana Sea Grant. 2013. Japanese Shore Crab (Hemigrapsus sanguineus). Urbana, IL. [Online]. Available: http://www.iisgcp.org/EXOTICSP/Japanese_Shore_Crab.htm. [Accessed: 23-Jan-2013].

Invasive Species Specialist Group (ISSG). 2013. Global Invasive Species Database. [Online]. Available: http://www.issg.org/database/species/ecology.asp?si=217&fr=1&sts=sss&lang=EN. [Accessed: 11-Jan-2013].

Jensen, G. C., P. S. McDonald, and D. A. Armstrong. 2002. East meets west: competitive interactions between green crab Carcinus maenas, and native and introduced shore crab Hemigrapsus spp. Marine Ecology Progress Series 225:251–262.

Kraemer, G. P., and M. Sellberg. 2001. Effects of the non-native crab Hemigrapsus sanguineus on crab community diversity at Edith Reed Santuary (Rye, NY) from 1998-2000. International Conference On Marine Bioinvasions, Louisiana State university, Baton Rouge 79.

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

McDermott, J. J. 1991. A breeding population of the western Pacific crab Hemigrapsus sanguineus (Crustacea: Decapoda: Grapsidae) established on the Atlantic coast of North America. The Biological Bulletin 181:195–198.

McDermott, J. J. 1998. The western Pacific brachyuran Hemigrapsus sanguineus (Grapsidae) in its new habitat along the Atlantic coast of the United States: reproduction. Journal of Crustacean Biology:308–316.

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